Macrothink Institute™

Business and Economic Research
ISSN 2162-4860
2017, Vol. 7, No. 1

The Role of Gender, Cognitive Attributes and Personality on Willingness to Take Risks

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Received: November 19, 2016 Accepted: December 18, 2016

doi:10.5296/ber.v7i1.10371 URL: http://dx.doi.org/10.5296/ber.v7i1.10371

Abstract

The aim of this research is to provide a further examination of the role gender plays as an influence on risk preferences. A combination of ordinary least squares (OLS) and logit regressions were carried out on data collected from 425 university students, including demographic and personality variables, along with GPA's and *CRT* scores. This study found females reported lower levels of willingness to take risks than males. In an addition to the current literature, it was found that females also achieved lower scores on a *cognitive reflection test (CRT)*. When separated by major, the gender gap was found to be the lowest for engineering and science students. None of CRT score, Maths GPA, or overall GPA were found to be correlated with risk willingness, suggesting societal conditioning as a possible cause of females being more risk averse than males. Personality variables along with gender were found to be correlated with willingness to take risk. These findings have implications for creating greater awareness of how females' different risk preferences are generated and managed.

Keywords: Risk Preferences, Gender Differences, Cognitive Reflection Test

1. Introduction

Although the notion that females are more risk averse than males has been examined thoroughly in existing literature, the reasons why are less well established. Some researchers such as Hibbert *et al*. (2008) have suggested women are no more risk averse than men once

education level is accounted for, while Frederick (2005) argued that the correlation between risk taking and cognitive ability went beyond the ability to calculate and consider expected value, leading him to suggest impulsivity played a role. The contribution this paper makes is to examine the influence of education level and cognitive aptitude on gender differences in risk taking using Frederick's (2005) measure of cognitive ability and impulsivity called the *Cognitive Reflection Test (CRT)* and Dohmen *et al*.'s (2007) measure of risk preferences. Specifically, this paper expands on Frederick's (2005) work by examining any gender bias in his *CRT measure*, an area not examined by Frederick himself. This paper also includes other demographic variables including personality, overall GPA and GPA in quantitative subjects to examine if a greater predilection for quantitative subjects, and thus a greater exposure to quantitative education lies behind the gender bias. As a result, this research will address a previously unexamined area of interest in the research on risk preferences by examining a potential gender bias in terms of males displaying a greater propensity for mathematical or quantitative subjects, which in turn improves their willingness and ability to examine risk and payoffs in risky situations, as a result of greater levels of education in quantitative subjects. The specific research questions being asked are:

1. What role does gender play in terms of any correlation with risk preferences?
2. What role does gender play in terms of any correlation with CRT score?
3. What role does CRT score play in terms of any correlation with risk preferences?
4. Which variables are correlated with risk preferences?

The purpose of question 1 is to establish if the same gender bias in risk preferences that has been identified in previous research exists in the cohort examined in this paper. Questions 2 and 3 expand on Frederick's work by introducing a gender focus, as well as examining whether his *CRT* score of 'cognitive impulsiveness' is correlated to risk preferences. Question 4 contributes to the current literature by establishing how personality and cognitive ability as measured by quantitative subject GPA as well as overall GPA are correlated to **risk preferences.**

2. Literature Review

The existence of a gender difference in risk perception has important implications, with Schubert *et al*. (1999) hypothesising that a perceived difference in gender risk attitudes could have a negative effect on females, including reduced job or promotion opportunities due to the perception they may be reticent to make necessary risky decisions, being offered less riskier (and hence lower return) investment options by financial brokers, and so on. Dohmen *et al*. (2007) echo this sentiment by claiming that "Risk and uncertainty play a role in almost every important economic decision" (p. 522), although Filippin and Crosetto (2014) in completing a detailed statistical analysis of microdata as well as a thorough analysis of the experimental literature, concluded that although gender differences are statistically significant, the effect size tends to be small in terms of economic outcomes. In an examination of how gender pertains to risk preferences in the experimental economics literature findings have also included that "women are more risk averse than men in the vast majority of environments and tasks" (Croson & Gneezy 2009, p. 449), consistent across lab experiments

and experiments conducted in the field. Possible explanations posited include different emotional reactions when faced with risk, gender based differences in whether risky situations are seen as a threat or an opportunity, and greater levels of over-confidence among men (Croson & Gneezy, 2009), a finding supported by others who have found "men exhibit relative overconfidence in significant corporate decision making compared with women" (Huang & Kisgen 2013, p. 822). Interestingly, greater levels or risk averseness have not been found to necessarily flow through to worse financial **outcomes for** firms when examining the performance of men relative to women, with examples of the performance of women equal to that of men (Francoeur & Sinclair-Desgagne, 2008) or superior (Krishan & Park, 2005) found. Nevertheless, gender differences are an important consideration for the providers of financial services in the areas of finance and investment.

The general consensus in the literature is that females are more risk averse than males, albeit with a slight amount of disagreement. Charness and Gneezy (2012) found woman to be more risk averse than men based on the fact that woman invested less in investment games. Eckel and Grossman (2002b) also used an experimental economics approach to come to the same conclusion that woman are more risk averse than men on average. Daruvala (2007) describes empirical studies suggesting women are more risk averse than men, albeit with evidence that is not clear-cut, with gender differences dependant on the environment. Daravula (2007) references several studies (Sunden and Surette(1998), Jianakoplos and Bernasek (1998), Bajtelsmit *et al*. (1999), Pålsson(1996), Levin, Snyder and Chapman(1988), Eckel and Grossman (2002a, b), Powell and Ansic (1997), Levy, Eron and Cohen (1999), Schmidt and Traub (2002); Brooks and Zank 2005) which find that woman are **more** risk averse than men, or women are more loss averse than men, when it came to financial decisions. However, they also site Schubert *et al*. (1999) stating that gender differences are not significant when decisions are contextual, leading Schubert *et al*. (1999) to question gambling experiments which can be abstract in nature. Daruvala (2007) also references Kruse and Thompson (2001, 2003) as well as Holt and Laury (2002) as researchers who have found contradictory findings to those mentioned above when investigating gender risk differences. In a study of university professors Hibbert *et al*. (2008) found women to be no more risk averse than men in terms of their portfolio holdings, leading them to claim that women are no more risk averse than men when both parties have the same level of education. Given that the sample was made up of finance and English professor**s**, this rather homogenous group of high socioeconomic status individuals (some of whom were trained in finance) may not fully capture the effect of societal influences as causes of gender differences in risk perceptions.

Whilst the above evidence generally points toward the existence of a gender effect in risk perceptions, the reasons for any gender differences are less well established, with Gustafson (1998) in a review of the risk literature concluding that gender differences in the perception of risk were often identified but also often left unexplained.

One theory is that gender differences in risk preferences are the product of a consumer's social environment. When trying to establish predictors of risk aversion, Guiso and Paiella (2008) concluded that it is the consumer's environment rather than household characteristics that is likely to predict risk aversion. They found that a consumer's income unpredictability

and constraint display a greater amount of relative risk aversion. Among other findings, Gustafson (1998) stated that most gender theorists would agree that "Gender differences should primarily be regarded as socially produced, not as biologically based, or "natural." (p. 809). This led Gustafson (1998) to propose a model incorporating gender structures, gendered ideologies and practice, leading to gender differences in risk exposure, handling and perception. When specifically discussing risk perception he theorised that "women and men may perceive the same risks differently, they may perceive different risks, and they may attach different meanings to what appear to be 'the same' risks" (p. 809). He did also warn that risk perception differences could be situation specific and be related to different activities and social roles, concluding that risk differences are overly simplified when reduced to statements about who perceives most risk (p. 810). Supporting the findings of Gustafson (1998), Finucane *et al*. (2000) suggest that gender and ethnic differences in risk preferences are complicated, suggesting 'further investigation of socio-political factors in risk judgements…. to clarify gender and racial differences' (p. 159). Others such as Booth and Nolan (2012) also support the notion that risk preferences may be a product of social learning rather than gender traits, based on their findings that girls in single sex schools displayed different risk preferences to girls in co-ed schools. In the field of financial literacy, which also displays a gender bias favouring men in terms of scores on financial literacy tests, Agnew and Cameron-Agnew (2015) found that financial conversations in the home between parents and children occurred at an earlier age with sons than with daughters, with evidence also suggesting financial discussions with daughters were at a more superficial level.

Dohmen *et al*. (2007) took the interesting approach of evaluating experiments and survey responses as measures of risk preferences. Their study compared self-reported responses on surveys to lottery-type experiments. The self-reported survey responses also used different contexts and approaches in assessing risk preferences. They found that risk preferences were "shown to be relatively stable across different contexts, shedding light on a deeper question about stability of willingness to take risks as a personal trait" (p. 542). Dohmen *et al*. (2007) also found the best all-round predictor to be a general risk question. On the other hand, asking about risk attitudes in a more specific context gives a stronger measure for the corresponding context.

An alternative hypothesis in the literature as to the reason for a gender difference in risk perceptions is the notion of a gender difference in financial knowledge or educational achievement. For example, Dwyer *et al*. (2001) suggest that the higher levels of female risk aversion reported in the literature may be substantially explained by differences in levels of financial knowledge. They found that when knowledge of financial markets and investments is controlled for, there was no significant gender difference in mutual fund investment decisions. In an analysis of seven studies, Stanovich and West 2008 suggest that people are subject to thinking biases which do not appear to be correlated with cognitive ability, however they did find that cognitive ability was correlated with avoiding some rational thinking biases. Although not presented as the cause of any gender difference in risk preferences, cognitive ability is also an attribute that has been suggested as having an impact on risk preferences. In their 2007 study, Dohmen *et al*. introduced the influence of cognitive

ability on impatience and risk aversion, through a serious of controlled experiments, finding lower cognitive **ability** to be correlated with greater risk aversion and impatience after controlling for various variables such as personal characteristics, educational attainment, income level and credit constraints. Frederick (2005) argued that cognitive abilities could possibly have an important casual influence on decision making. To test this notion, Frederick (2005) introduced three questions as a measure of one type of cognitive ability - a three-item 'Cognitive Reflection Test' (*CRT*). The three questions were:

1. A bat and a ball cost $1.10. The bat costs $1.00 more than the ball. How much does the ball cost (in cents)?
2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take100 machines to make 100 widgets (in minutes)?
3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake (in days)?

This test was designed to test for impulsivity, being made up of three questions where the intuitive, impulsive answer is incorrect. The test results were then used as a proxy for impulsiveness, with those who answer the three questions correctly (lower impulsivity) compared with those who did not answer any correctly (higher impulsivity). For gambles involving gains (a higher expected return or a lower guaranteed return) Frederick (2005) found the high *CRT* score group were more willing to gamble than the low *CRT* group when expected return was greater than a guaranteed return, and when expected return was the same as a guaranteed return. From this Frederick (2005) deduced that "the correlation between cognitive ability and risk taking in gains is not due solely to a greater disposition to compute expected value or to adopt that as the choice criterion" (p. 33). When Frederick (2005) used gambles with choices of a guaranteed loss or expected losses, the low *CRT* group illustrated classic *Prospect Theory* (Kahneman and Tversky, 1979), being much more willing to take a gamble to avoid losses then to take a gamble to collect winnings. The high *CRT* group however did not display this characteristic. It is these findings by Frederick's (2005) that this research endeavours to build upon by applying the *CRT* to risk preferences.

3. Method

A sample of 425 students from an established university in New Zealand completed a questionnaire online. A link to the questionnaire was emailed out to a cohort of students who had registered on a database for students interested in participating in research with the university's experimental economics laboratory. As an incentive to participate, students who participated went in the draw for $500 worth of cash prizes. The 425 students who completed the questionnaire represented approximately a 33% response rate from the cohort registered on the database.

A combination of ordinary least squares (OLS) and logit multiple regressions were then carried out on the data, depending on the nature of the dependant variable. Variables included in the quantitative analysis could be thought of as falling into three groups.

Group one includes dummy variables for the demographic characteristics of *ethnicity* (Caucasian = 1), *age* (<21 = 1), *gender* (male = 1), *international student (international = 1), father's education* (father graduated university = 1) and *mother's education* (mother graduated university = 1). These variables are included to account for any social and environmental effects arising from differing backgrounds. The parental education variables are included as a proxy for socioeconomic status.

The second group of variables includes *overall GPA, maths GPA* and *stats GPA.* These three GPA variables are based on an 11 point interval scale (E = -1, A+ = 9), and included to account for a student's numerical dexterity and overall cognitive ability, thus accounting for the possibility that males may be more likely to engage in subjects requiring greater numerical ability, and receiving a higher level of numerical education than females. With these variables included, the concern raised by Hibbert *et al*. (2005) that differing education levels lay behind the gender bias in risk preferences has been recognised and allowed for.

The third group of variables includes six variables that could be thought of as measures of impulsivity and risk preference. The first three variables are *CRT score:* an ordinal variable between 1 and 3, consisting of the score participants received on the three question Cognitive Reflection Test devised by Frederick (2005), *impulsiveness:* an ordinal variable showing each student's response to the statement 'I tend to be impulsive' on a five point Likert scale (1 = strongly disagree, 5 = strongly agree) and *risk willingness:* an 11 point interval variable where participants mark on a continuum from 0 to 10, how willing they are to take risks (0 corresponding to not at all willing and 10 corresponding to very willing).

The risk willingness variable was that developed by Dohmen *et al*. (2007), who compared questionnaire responses to those elicited from field experiments, in order to examine the question of whether self-reported answers on questionnaires were representative of participants' actual risk-taking behaviour. They found that 'The question about risk taking in general generates the best all-round predictor of risky behavior' (p. 522). The remaining three variables are personality variables of *extraversion, conscientiousness* and *neuroticism*. These are ordinal in nature, and derived from the Mini IPIP (Donnellan *et al*., 2006). The remaining two IPIP personality variables of agreeableness and openness were not included as previous studies have suggested they are less strongly correlated with alternative personality measures (Gow *et al*., 2005). Table one shows descriptive data of the final variables.

Table 1. Descriptive Data of Variables Included in Regressions

	Range	Mean	Standard Error
I tend to be impulsive	1 to 5	2.74	0.047
Extravert	4 to 20	11.49	0.168
Conscientiousness	4 to 20	13.92	0.143
Neuroticism	4 to 20	11.16	0.153
CRT Score	0 to 3	1.82	0.056
Risk Willingness	0 to 10	5.87	0.106
Domestic Student	0 to 1	0.07	0.012
Male Student	0 to 1	0.50	0.024
Aged 21+	0 to 1	0.43	0.024
Mother Graduated University	0 to 1	0.41	0.024
Father Graduated University	0 to 1	0.44	0.024
Caucasian Ethnicity	0 to 1	0.22	0.020
Maths GPA	0 to 9	1.93	0.149
Stats GPA	-1 to 9	2.92	0.169
Overall GPA	-0.50 to 9	5.14	0.109

For the OLS regressions run in this paper, plots of the data confirmed normal and linear distributions, with no sign of heteroscedasticity. Variance inflation factors ranging from 1.048 to 1.477 and a Cook's maximum distance between 0.024 and 0.041 were also within acceptable ranges confirming neither multicollinearity nor outliers were an issue. Pearson and Spearman correlation coefficients were also calculated, with the Pearson correlation coefficients for the interval data revealing no or small correlations for all variables with the exception of the *maths GPA* and overall *GPA* variables which yielded a coefficient of 0.353, still at the low end of a medium correlation. The Spearman correlation coefficients all fell between no or low medium correlation, with the highest correlation coefficient being 0.321.

4. Results

Table 2 shows the results of a logit regression run to establish any significant differences in the variables between male and female participants. The sample was also stratified according to major to establish if there are any significant differences across different 'types' of students. Across the full sample and each sub-sample by major, males exhibited a higher willingness to take risks on the 11 point general risk scale. Males exhibited significantly higher scores on the three question CRT apart from those with a science/engineering major. This intuitively makes sense, in that science and engineering are fields that require a higher level of calculation or mathematical skills. The females majoring in this field are thus more likely to have greater numerical analytical skills, by necessity. The only other consistent difference was that males tended to be significantly less neurotic than females, apart from those majoring in the arts/psychology.

Table 2. Odds Ratios Showing Variables Correlated With Gender

	Full Sample	Commerce Major	Science Major	Arts Major
International Student	0.766	0.352	0.927	0.434
Aged 21+	0.823	0.891	0.707	0.963
Non-Caucasian Ethnicity	1.305	1.053	5.027	1.218
Father Graduated University	0.795	0.554	1.066	1.044
Mother Graduated University	0.746	0.575	1.283	1.349
Extravert	0.924**	0.960	0.968	0.889
Conscientious	0.968	0.808***	1.172	0.984
Neurotic	0.825***	0.859**	0.769***	0.853
CRT Score	1.838***	2.019***	1.491	1.561**
Risk Willingness	1.311***	1.424***	1.260**	1.428***

** and *** denote statistical significance at the 5 and 1% levels respectively.

Using the odds ratio formula of (odds ratio x 100) - 100 to interpret the odds ratios as percentages, by far the biggest gender differences were on the CRT scores and the general risk question. For the full sample, males reported 7.6% lower levels of extraversion and 17.5% lower levels of neuroticism. However, males scored 83.8% higher on the CRT and reported 31.1% higher levels of general risk willingness than females. For commerce majors, males reported 19.2% lower levels of conscientiousness and 14.1% lower levels of neuroticism, but a much larger 101.9% higher on the CRT test and 42.4% higher levels of general risk willingness. For science and engineering majors, males reported 23.1% lower levels of neuroticism than females and 26% higher levels of risk willingness than females. For arts and psychology majors, males scored 56.1% higher on the CRT and reported 42.8% higher levels of risk willingness.

Given the findings of Dohmen *et al.* (2007) mentioned above, a self-reported statement asking for the level of agreement on a five point Likert scale (1=strongly disagree, 5=strongly agree), with the statement ‘I tend to be impulsive’ was introduced into the regressions. Maths, statistics and overall GPA’s were also included where appropriate (GPA’s are on an 11 point scale from -1 for an E to a 9 for an A+). The justification for including the impulsiveness statement and GPA’s was to see if the CRT score and general risk willingness remain significant even including cognitive ability, mathematical cognitive ability, and self-reported levels of impulsiveness. The results are shown in Table 3.

Table 3. Odds Ratios Showing Variables Correlated with Gender - GPA's and Impulsiveness Statement Included

	Full Sample	Commerce Major	Science Major	Arts Major
International Student	0.552	0.345	0.345	0.132
Aged 21+	0.817	0.811	0.783	1.043
Non-Caucasian Ethnicity	1.167	1.002	6.014	1.044
Father Graduated University	0.762	0.487	1.525	1.044
Mother Graduated University	0.720	0.613	0.581	1.327
Extravert	0.911**	0.953	0.936	0.874
Conscientious	1.019	0.832**	1.313***	1.014
Neurotic	0.809***	0.841**	0.658***	0.876
CRT Score	1.738***	2.120***	2.151**	1.371
Risk Willingness	1.288***	1.395***	1.321**	1.501***
Stats GPA	1.027	0.941	1.274**	1.008
Math GPA	1.248***	1.072	1.676***	1.586**
Overall GPA	0.821***	1.000	0.593***	0.880
Impulsiveness	1.408**	1.393	2.526**	0.986

** and *** denote statistical significance at the 5 and 1% levels respectively.

Of the newly introduced variables, males showed significantly higher maths GPA's apart **from** the commerce sample; higher statistics GPA in the science and engineering sample but lower overall GPA's in the overall and science and engineering sample**s**. Males self-reported higher impulsiveness levels in the overall sample and the science and engineering sub-sample. The personality variables that were significant in Table 2 remained significant in Table 3 with the exception of conscientious no longer being significant in the science and engineering segment. Including these additional variables, (with Table 2 equivalent in brackets) for the overall sample males still scored 73.8% (83.8%) higher on the CRT and 28.8% (31.1%) higher levels of risk willingness than females. For commerce majors, males scored 112% (101.9%) higher on the CRT and reported 39.5% (42.4%) higher levels of risk willingness, with the corresponding percentages for the science and engineering sample being 115.1% and 32.1% (26%). For arts and psychology majors there was no significant difference for CRT score (56.1%), with males reporting 50.1% (42.8%) higher levels of risk willingness than females.

These results show there is still a consistent gender effect on self-reported general level of willingness to take risks in the full sample as well as each of the segments by major, even after accounting for personality, demographics, GPA's and self-reported impulsiveness. There also appears to be a significant gender effect on the CRT score, which was not examined in Dohmen *et al.*'s (2007) original paper. This is verified in Table 4, where two OLS regressions were run with CRT score and the general risk willingness question as the dependant variables.

Table 4. OLS Coefficients and t-statistics Showing Variables Correlated with Risk Willingness and CRT Score

	CRT Score	Risk Willingness
International Student	0.036 (0.154)	-0.175 (-0.387)
Aged 21+	0.094 (0.901)	0.084 (0.416)
Non-Caucasian Ethnicity	-0.340** (-2.314)	-0.220 (-0.768)
Father Graduated University	-0.024 (-0.201)	-0.144 (-0.631)
Mother Graduated University	0.218 (1.829)	0.038 (0.163)
Extravert	-0.036** (-2.274)	0.140*** (4.633)
Conscientious	-0.054*** (-3.050)	0.017 (0.486)
Neurotic	-0.008 (-0.428)	-0.078** (-2.262)
CRT Score	----------	-0.051 (-0.531)
Risk Willingness	-0.014 (-0.531)	----------
Stats GPA	0.030 (1.919)	-0.004 (-0.124)
Math GPA	0.068*** (3.546)	-0.020 (-0.531)
Overall GPA	0.001 (0.047)	0.003 (0.058)
Impulsiveness	-0.117** (-2.034)	0.425*** (3.863)
Male Gender	0.612*** (5.266)	0.963*** (4.218)
Adjusted R^2	0.198	0.151

** and *** denote statistical significance at the 5 and 1% levels respectively.

After accounting for personality, demographics, GPA's and self-reported impulsiveness, a male on average scored 0.6 of a mark higher than a female on the three question CRT, and almost one full number on the 11 point general risk question continuum. However, when an OLS regression was applied with the general willingness to take risks variable as the dependant variable, the CRT score was not significant.

Finally, a step-wise OLS regression was run with the dependant variable of the self-reported general risk willingness. The four significant variables identified by the regression are shown in Table 5. Gender had the largest effect size with males reporting 0.9 of one full point on the 11 point scale higher general risk willingness. The self-reported impulsiveness variable had an effect size of 0.41, meaning a 1 point increase on the five point Likert scale (strongly disagree to strongly agree) increases the score on the 11 point general risk willingness scale by 0.41 of a point. A one point higher response on the four item Mini IPIP scale for extraversion results in a 0.15 of one point higher score on the general risk continuum, with a one point higher response on the four item Mini IPIP scale for neuroticism resulting in a small effect size of a 0.08 of one point lower score on the general risk continuum. Given these results, on average, a male who reports higher levels of impulsiveness and extraversion, with lower levels of neuroticism will record higher levels of general risk willingness.

Table 5. OLS Coefficients and t-statistics Showing Variables Significantly Correlated with Risk Willingness

Risk Willingness	Full Sample
Gender	0.901***
	(4.379)
Extravert	0.147***
	(5.002)
Neuroticism	-0.079**
	(-2.339)
Impulsiveness	0.411***
	(3.941)
Adjusted R^2	0.165

** and *** denote statistical significance at the 5 and 1% levels respectively.

5. Discussion

In answering the research questions identified earlier, the sample of university students used in this paper clearly displayed a gender difference in risk aversion. This finding is supportive of similar findings in the literature, that females are more risk averse than males. The metric of risk aversion used was a self-reported level of risk aversion on a general risk continuum, developed by Dohmen *et al*. (2007). Fears of the validity of using a self-reported measure are allayed by Dohmen *et al*. (2007) finding the general risk continuum metric to be a reliable measure when compared to field experiment data. The level of gender difference was significant, even after accounting for CRT score, demographic and personality variables, with an effect size of 31.1% higher levels of risk willingness among males than females. As mentioned earlier, this level of increased risk aversion among females may lead to different financial and economic outcomes, as females gravitate toward ‘safer’ investment opportunities with lower rates of return. But what is the catalyst for this tendency of females to err on the side of caution? With the literature suggesting societal conditioning, cognitive

ability or differences in levels of cognitive reflection as possible influences, the data in this study was also segmented by major. If societal conditioning and quantitative ability have an influence on risk aversion, than one might expect in fields such as engineering and science, in which males are over-represented, and greater levels of numeracy are required, that the gender difference in risk aversion may be smaller. Females who are majoring in science or engineering will have already displayed a propensity for numeracy, and have not been dissuaded by the traditional male domination of these industries. The results in this paper do lend some support to this notion, with science and engineering majors displaying a lower level of risk aversion among females (26%) compared to commerce (42.4%) and psychology and arts majors (42.8%). While previous research has used experiments to assess risk aversion, which require a certain competence in numeracy to calculate rates of risk relative to return, the general risk continuum used in this paper removes the requirement for numerical aptitude, suggesting the differential gender risk aversion by major identified above may be due more to societal influences. Females who are majoring in male dominated fields have already broken down societal stereotypes to some degree, so are less likely to be influenced by gender-based stereotypes in other aspects of their lives.

In answering the second research question of what role does gender play in terms of any correlation with CRT score, the regressions showed that CRT score displayed a similar gender effect to the general risk question, with an even larger effect size. A similar effect was seen as with the general risk variable, when the data was segmented according to major. While male commerce majors on average scored just over 100% more on the CRT, the **(~~same~~)** equivalent figure for arts and psychology majors was 56%, and for science and engineering majors 49%.

Given Frederick (2005) examined risk aversion using the CRT as a possible proxy for impulsivity, and the fact that the CRT questions do require a level of numeracy; maths and statistics GPA's along with overall GPA, as well as a self-assessed impulsiveness variable were introduced into the original regression with gender as the dependant variable. While males had significantly higher statistics and maths GPA, but a lower overall GPA, this was driven predominantly by the science and engineering students. The fact that even allowing for numeracy and cognitive ability, males still reported higher levels of general risk taking and higher CRT scores, suggests CRT score is capturing something other than numerical ability. The CRT could potentially be capturing impulsivity, with males also self-reporting higher levels of impulsiveness, although it is predominantly the science and engineering students driving this result.

Given the findings thus far that males report higher levels of general risk taking, and score higher on a cognitive reflection test, regressions were run to see if these two variables were correlated with each other. No such correlation was found, which contradicts the findings of Fredericks (2005). One possible reason for this is that Fredericks' (2005) compared risk propensity between the high CRT score (3 out of 3) group and the low (0 out of 3) CRT group, exacerbating the effect of CRT score. In this study, all participants and their CRT scores were included. After accounting for personality, cognitive ability, general risk willingness and demographic variables, most of the variables correlated with CRT score made intuitive sense.

On average, those with a higher CRT score were males, and students with a higher Math GPA. Variables correlated with a lower CRT score were students who self-reported as more impulsive, self-identified as extroverts, and were non- Caucasian in ethnicity. The only intuitively puzzling correlation was students who self-identified as being more conscientious scored lower CRT scores all other variables held constant.

In answering the question of what role does CRT score play in terms of any correlation with risk preferences we can say that CRT score had no influence on risk willingness. Although CRT score was correlated with greater impulsivity, which was also correlated with high risk willingness, even when the self-reported impulsiveness variable was not included in the regression with risk willingness as the dependant variable, CRT score was still not significant. The variables that were significantly correlated with general risk-taking paint a clear, intuitive picture. Participants who self-identified as having higher levels of extraversion were more likely to identify themselves as greater risk-takers, as were participants who saw themselves as being impulsive. Those participants who saw themselves as being more neurotic reported lower levels of risk willingness, which intuitively makes sense if one equates neuroticism with worry. The remaining significant variable was gender, with males displaying higher levels of risk willingness. Given that variables which proxy for numeracy and cognitive ability were not significant, this finding provides support for the literature that emphasises the role social conditioning plays in risk-willingness differences between the genders.

6. Conclusion

Decision-making around risk is pervasive in society, ranging from purchasing of adventure tourism products such as bungy-jumping to purchasing decisions around financial products in the debt, investment and insurance fields. The existence of a propensity for females to be more risk averse has quality of life implications for customers, but also has implications for the providers of these services. The findings in this paper that cognitive ability, mathematical ability and cognitive reflection test scores are not correlated with risk preferences provides evidence for the notion that it is not an inability to perform risk versus return calculations which are responsible for differing risk preferences among the genders, even when female participants had lower Maths GPA's than males. Rather, once mathematical ability is dismissed as a potential cause, the remaining argument in the literature is that differing gender-based risk preferences are indicative of genuine risk preferences developed through social conditioning. When answering the research questions posed at the start of this paper, the main contribution of this research is to provide evidence against the role of cognitive reflection and numeracy in risk preferences differences. Males report higher levels of risk willingness, and higher scores on a cognitive reflection test. However, CRT scores are not correlated with risk preferences, rather gender, self-reported impulsiveness, along with the personality attributes of extraversion and neuroticism are correlated with risk preferences.

References

Agnew, S., & Cameron-Agnew, T. (2015). The influence of consumer socialisation in the home on gender differences in financial literacy. *International Journal of Consumer Studies, 39*(6), 630-638. https://doi.org/10.1111/ijcs.12179.

Bajtelsmit, V., Bernasek, A., & Jianakoplos, N. (1999). Gender differences in defined contribution pension decisions. *Financial Services Reviews, 8,* 1-10. https://doi.org/10.1016/S1057-0810(99)00030-X.

Booth, A., & Nolan, P. (2012). Gender differences in risk behaviour: Does nurture matter? *The Economic Journal*, February, 56-78. https://doi.org/10.1111/j.1468-0297.2011.02480.x.

Brooks, P., & Horst, Z. (2005). Loss averse behaviour. *Journal of Risk and Uncertainty, 31*(3), 301-325. https://doi.org/10.1007/s11166-005-5105-7.

Charness, G., & Gneezy, U. (2012). Strong evidence for gender differences in risk taking. *Journal of Economic Behavior & Organization, 83,* 50-58. https://doi.org/10.1016/j.jebo.2011.06.007.

Croson, R., & Gneezy, U. (2009). Gender differences in preferences. *Journal of Economic Literature, 47,* 1-27. https://doi.org/10.1257/jel.47.2.448

Dohmen, T., Falk, A., Huffman, D., & Sunde, U. (2007). Are risk aversion and impatience related to cognitive ability? *IZA Discussion Papers*, No. 2735. Retrieved 7/8/2016. http://nbn-resolving.de/urn:nbn:de:101:1-20080402396

Daruvala, D. (2007). Gender, risk and stereotypes. *Journal of Risk and Uncertainty, 35*(3), 265-283. https://doi.org/10.1007/s11166-007-9024-7.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., & Wagner, G. (2011). Individual risk attitudes: Measurement, determinants, and behavioural consequences. *Journal of the European Economic Association, 9*(3), 522-550. https://doi.org/10.1111/j.1542-4774.2011.01015.x.

Donnellan, M., Oswald, F., Baird, B., & Lucas, R. (2006). The mini-IPIP scales: Tiny-yet-effective measures of the big five factors of personality. *Psychological Assessment, 18*(2), 192-203. https://doi.org/10.1037/1040-3590.18.2.192.

Dwyer, P., Gilkeson, J., & List, J. (2002). Gender differences in revealed risk taking: evidence from mutual fund investors. *Economics Letters, 76,* 151-158. https://doi.org/10.1016/S0165-1765(02)00045-9.

Eckel, C., & Grossman, P. (2002a). Forecasting risk attitudes: an experimental study of actual and forecast risk attitudes of women and men, Department of Economics, Virginia Tech, unpublished manuscript.

Eckel, C., & Grossman, P. (2002b). Sex differences and statistical stereotyping in attitudes toward financial risk. *Evolution and Human Behavior, 23,* 281-295. https://doi.org/10.1016/S1090-5138(02)00097-1.

Francoeur, C., Labelle, R., & Sinclair-Desgagne, B. (2008). Gender diversity in corporate governance and top management. *Journal of Business Ethics 81,* 83-95. https://doi.org/10.1007/s10551-007-9482-5

Filippin, A., & Crosetto, P. (2014). A reconsideration of gender differences in risk attitudes.

IZA Discussion Papers, No. 8184.

Finucane, M., Slovic, P., Mertz, C., Flynn, J., & Satterfield, T. (2000). Gender, race, and perceived risk: The 'white male' effect. *Health, Risk & Society, 2*(2), 159-172. https://doi.org/10.1080/713670162.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives, 19*(4), 25-42. https://doi.org/10.1257/089533005775196732.

Gow, A., Whiteman, M., Pattie, A., & Deary, I. (2005). Goldberg's 'IPIP' Big-Five factor markers: Internal consistency and concurrent validation in Scotland. *Personality and Individual Differences, 39*, 317-329. https://doi.org/10.1016/j.paid.2005.01.011.

Guiso, L., & Paielle, M. (2008). Risk aversion, wealth and background risk. *Journal of the European Economic Association, 6*(6), 1109-1150. https://doi.org/10.1162/JEEA.2008.6.6.1109.

Gustafson, P. (1998). Gender differences in risk perception: Theoretical and methodological perspectives. *Risk Analysis, 18*(6), 805-811. https://doi.org/10.1023/B:RIAN.0000005926.03250.c0.

Hibbert, A., Lawrence, E., & Prakash, A. (2008). Are women more risk-averse than men? Retrieved 10/1/2016. URL:https://www.researchgate.net/profile/Arun_Prakash9/publication/228434430_ARE_WOMEN_MORE_RISKAVERSE_THAN_MEN/links/00b7d519bf2e7838ec000 000.pdf

Holt, C., & Laury, S. (2002). Risk aversion and incentive effects. *The American Economic Review, 92*(5), 1644-1655. https://doi.org/10.1257/000282802762024700.

Huang, J., & Kisgen, D. (2013). Gender and corporate finance: Are male executives overconfident relative to female executives? *Journal of Financial Economics, 108*, 822-839. https://doi.org/10.1016/j.jfineco.2012.12.005

Jianakoplos, N., & Bernasek, A. (1998). Are women more risk averse? *Economic Inquiry, 36*, 620-630. https://doi.org/10.1111/j.1465-7295.1998.tb01740.x.

Kahneman, D., & Tversky, A. 1979. Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263-291. https://doi.org/10.2307/1914185.

Krishnan, H., & Park, D. (2005). A few good women - on top management teams. *Journal of Business Research, 58*, 1712-1720. https://doi.org/10.1016/j.jbusres.2004.09.003

Kruse, J., & Thompson, M. (2001). A comparison of salient rewards in experiments: Money and class points. *Economics Letters, 74*(1), 113-117. https://doi.org/10.1016/S0165-1765(01)00530-4.

Kruse, J., & Thompson, M. (2003). Valuing low probability risk: Survey and experimental Evidence, *Journal of Economic Behavior and Organization, 50*, 495-505. https://doi.org/10.1016/S0167-2681(02)00039-2.

Levin, I., Snyder, M., & Chapman, D. (1988). The interaction of experiential and situational factors and gender in a simulated risky decision-making task. *The Journal of Psychology, 122*, 173-181. https://doi.org/10.1080/00223980.1988.9712703.

Levy, H., Efrat, E., & Allon, C. (1999). Gender differences in risk taking and investment behavior: An experimental analysis. The Hebrew University, unpublished manuscript.

Pålsson, A. (1996). Does the degree of relative risk aversion Vary with household characteristics? *Journal of Economic Psychology, 17*, 771-787. https://doi.org/10.1016/S0167-4870(96)00039-6.

Powell, M., & Ansic, D. (1997). Gender differences in risk behaviour in financial decision-making: An experimental analysis. *Journal of Economic Psychology, 18*, 605-628. https://doi.org/10.1016/S0167-4870(97)00026-3.

Schmidt, U., & Traub, S. (2002). An experimental test of loss aversion. *Journal of Risk and Uncertainty, 25*(3), 233-249. https://doi.org/10.1023/A:1020923921649.

Schubert, R., Brown, M., Gysler, M., & Brachinger, H. (1999). Financial decision-making: Are women really more risk-averse? *The American Economic Review, 89*(2), 381-385. https://doi.org/10.1257/aer.89.2.381.

Stanovich, K., & West, R. (2008). On the relative independence of thinking biases and cognitive ability. *Journal of Personality and Social Psychology, 94*(4), 672-695. https://doi.org/10.1037/0022-3514.94.4.672.

Sunden, A., & Surette, B. (1998). Gender differences in the allocation of assets in retirement savings plans. *American Economic Review, 88*(2), 207-211.

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