

# Indecisiveness on risk preference and time preference choices. Does financial literacy matter?<sup>1</sup>

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## Abstract

The aim of this study is to investigate the relationship between financial literacy and decisiveness in making risk preference and time preference choices by university students. The study collected data using a questionnaire, implemented a multiple price list risk preference and time preference experiment, and administered a financial literacy test on 192 university students (female=53%). A maximum of 7 680 risk preference and 7 680 time preference choices were elicited from the university students. An ordinary least squares regression model show that multiple switching or indecisiveness on risk preference and time preference choices increases as financial literacy decreases. University students with low financial literacy are more likely to switch back-forth between binary lotteries. Low financial literacy increases behavioural biases and short cuts in making preference choices. Being financial literate helps university students to be decisive in making risk and time preference choices.

**Keywords:** risk preferences, time preferences, financial literacy, indecisiveness, experiment, multiple price list, multiple switching

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## **Introduction**

Financial capability and good money management are important in ensuring better financial outcomes. Good money management involves making choices with fewer mistakes that maximize one's benefits and utility. Differences in levels of financial literacy have been found to influence variation in financial behaviour (M. C. J. van Rooij, Lusardi, & Alessie, 2011). Financial decision-making involves intertemporal choices in an environment where risk is inherent (Michaud, 2017). To improve wellbeing and financial outcomes, individuals need to make decisive risk preference and time preference choices. Making decisions involves a host of factors that are engraved in formal learning and environmental observation (Courtney, 2001). Researchers have affirmed the impact of financial literacy on financial planning and choices amongst citizens (Lusardi & Mitchell, 2011). Making optimal choices is subject to 'behavioural biases' or 'short cuts' especially if individuals have limited information at their disposal (Capuano & Ramsay, 2011). Financial literacy represents information that an individual hold regarding handling finances. This raises the question; does financial literacy influence individual preference choices?

The aim of this research is to explore the relationship between financial literacy and decisiveness in making risk preference and time preference choices. It seeks to examine if variation in financial literacy influence the way individual make risk preference and time preference choices. The research also investigates factors that are associated with financial literacy of university students. The prominent question that requires an empirically tested behavioural finance outcome is, 'are there variations in risk preference and time preference choices exhibited by people with different levels of financial literacy?' Does financial literacy influence decisiveness in making risk preference and time preference choices? An answer to these questions will provide a deeper understanding of the role played by financial literacy in shaping up individual financial life outcomes.

The possibility that the level of financial literacy correlates with risk and time preferences choices is important for a minimum of two reasons. First, differences in financial behaviour due to level of financial literacy can sum up to market outcomes, which may make it possible for authorities to prescribe public policies to reduce the adverse effects. Secondly, the evidence is critical in assessing short run psychological behaviour (temptation) and long run optimization of individual with different levels of financial literacy. Choices made by individuals over time represent long run optimization while choices with probability of risk have aspects of temptation (Benjamin et al., 2013; Brocas and Carillo, 2006; Burks et al., 2009). Indecisiveness is an exhibition of doubt or indifference concerning two or more possible choices (Eliaz & Ok, 2006). Indecision is a common characteristic among people, which makes it important to understand possible causes of such behaviour (Qiu & Ong, 2017). Inability to rank choices according their worthiness lead individuals to be indecisive. The prevalence of informational background variation created by financial literacy level differences held by individuals can play a role in making choices. Laboratory experiment behaviour exhibited by the students can resemble the action taken by individuals in the market. Observations from previous studies show the differences in financial outcomes across individuals with different levels of financial literacy (van Rooij, Lusardi & Alessie, 2011). What is not clear is how financial literacy impact decision-making when making preference choices.

The study used an ordinary least squares regression model. Indifference or indecisiveness on risk preference and time preference lotteries increases as the level of financial literacy decreases, showing that students with low financial literacy are more likely to struggle to make risk preference and time preference choices. Our findings show that financial literacy plays an important role in financial decision-making. The paper concluded that indifference (multiple switching on binary lotteries) or indecisiveness is significantly more prevalent in risk preferences tasks than in time preference tasks.

The uniqueness of this study stems from the fact that to the best of our knowledge it is the first to make use of multiple price list (MPL) experimental methodology to examine the relationship between financial literacy and decisiveness in making risk preference and time preference choices in South Africa. Studies on financial literacy in South Africa have generally focused on financial literacy levels of citizens (Shambare & Rugimbana, 2012; Schwella & van Nieuwenhuyzen, 2014) . Other studies have used cognitive instruments such as intelligent quotient (IQ) tests to examine the impact of cognitive ability on risk preferences and time preferences (Benjamin et al., 2013; Dohmen et al., 2010). Our findings compare with the studies below. Lusardi and Mitchell (2007) found out that financial education is beneficial to people with low financial literacy. Becchetti et al (2013) in an experimental study with high school students found out that financial literacy education helped students who initially had low level of financial literacy. Jacobson and Petrie (2009) found out that subjects more likely to make mistakes were less likely to belong to savings group and had low financial literacy. Prasad and salmon (2013) in their experiment found out that subjects that make consistent choices are more likely to earn higher rewards.

The structure of the paper is as follows. The next section looks at the literature on the issues under study followed by experimental procedure and summary statistics, results and findings. Conclusion forms the final section.

## **Literature review**

Financial decisions involve making choices that might have risk preference and time preference situations. Economic agents faced with risk preference and time preference choices are known to exhibit varied behavioural outcomes mainly driven by cognitive ability, affection, habit formation, visceral influences, temptation, and anticipatory utility (Van Rooij et al., 2007; Frederick, 2005; Frederick et al., 2002). The quest to understand the difference in financial life outcomes that prevail between high financial literacy and low financial literacy individuals require a clear assessment of how economic agents make risk preference and time preference choices. There is need to investigate factors the influence how individual make risk preference and time preference choices. Research evidence show that individuals are prone to making financial errors especially individual with low financial literacy (Lusardi and Mitchell, 2011). Individuals with low financial literacy usually accumulate low levels of savings for their retirement (Lusardi & Mitchell, 2007).

Financial literacy education is helpful when targeted on individuals who lack financial literacy (Becchetti, Caiazza & Coviello, 2013; van Rooij, Lusardi & Alessie, 2011). It is important to understand the role that financial literacy play in shaping time preference and risk preferences outcomes. Financial knowledge, numeracy, ability to make beneficial financial decision and ability to use financial skills are weakly associated with cognitive ability (Delavande, Rohwedder, & Willis, 2008). Risk preferences entail making choices with a chance of a gain

or a loss while time preferences encompasses intertemporal choices, that is, choices over time (Frederick, 2005). To maximize benefits from risk preferences and time preferences one has to make a decisive choice.

When individuals are undecided, they treat dominated lotteries as un-dominated lotteries (Danan, Guerdjikova, & Zimmer, 2012). Information asymmetry created by low levels of financial literacy may increase behavior biases and short cuts in making choices. Being decisive might help individuals to settle for choices that improve their welfare. There is evidence that show that being decisive help individuals to achieve their academic goals (Baker, 1965). Jacobson and Petrie (2009) in an experimental study with an adult population in Rwanda that focused on how mistakes over risk preferences explain financial decisions concluded that risk aversion and inconsistent lottery choices interact significantly. Prasad and salmon (2013) used a principal-agent experiment and found that subjects who make consistent choices earn more money than those who make inconsistent choices. Inconsistent choices are a clear movement away from the assumptions of the expected utility theory. Research under expected utility theory has frequently ignored inconsistent behaviour and treated it as unobserved and uninformative noise (Jacobson & Petrie, 2009).

In a bid to investigate factors the influence decision-making, studies have used cognitive instruments such as IQ tests to examine the impact of cognitive ability on risk preferences and time preferences. Some of the researches that examined the relationship between risk preferences and time preferences with cognitive ability are (Benjamin et al., 2013; Dohmen et al., 2010; Huck and Weizsacker, 1999; Parker and Fischhoff, 2005). It is quite evident that a number of South African citizens lack financial literacy. Studies on financial literacy in South Africa have mainly focused on level of financial literacy among citizens and a number of the studies reported low levels of financial literacy (Shambare & Rugimbana, 2012; Roberts, Struwig & Gordon, 2014). This study goes beyond investigating the level of financial literacy amongst students. It examines the influence of financial literacy in decision-making.

## **Experimental procedure and summary statistics.**

### **Sample**

Our evidence comes from a laboratory experiment with students at University of the Free State South Africa as the subjects. These subjects were pursuing a Bachelor of Commerce degree in the Economic and management Sciences Faculty. One hundred and ninety-two (192) subjects participated in multiple price list (MPL) risk preference and time preference experiment. About 53% of the subjects were female and programs pursued by the students ranged from Bachelor of commerce in economics, investment, law, administration, accounting, entrepreneurship, marketing, business management and human resources. All the students were enrolled for a Personal Finance module taught between August to December 2016. The data was collected from the students before students were taught content on the Personal Finance module, which is a financial literacy course. The university students also wrote a financial literacy test to gauge their financial literacy level. The subjects completed a total of four MPL risk preference and four MPL time preference tasks. In total, the subjects made a maximum of 7680 risk preference and 7680 time preference choices. All subjects who score a mark above average in the financial literacy test were categorised as high financial literacy group while those who score a mark below average were classified as low financial literacy group.

## **Procedure**

The study uses Multiple Price List (MPL) experimental procedure modified to suit South African currency and context by the Research Unit in Behavioural Economics and Neuroeconomics (RUBEN) at the University of Cape Town in South Africa (Harrison et al., 2005; Holt and Laury, 2002; Andersen et al., 2008). Subjects completed (four) risk aversion and (four) time preference tasks. Each task had 10 binary choices meaning that each subject completed 80 choices. Ten percent of the participants received actual payment of money for their choices from randomly chosen game that they played (Andersen et al., 2008).

The selection process for payment was by quota random sampling. A number of tickets equal to the number of participants were put in a hat. Participants drew tickets from the hat without replacement. Ten percent of the tickets were winning tickets. After picking a winning ticket, subjects tossed a 10-sided dice until a number between 1 and 8 inclusive appears. If a number between 1 and 4 inclusive appeared after tossing a dice, the subject was paid for a time preference task, where '1' represented Task 1 and '4' represented Task 4. If the participant tosses a dice and a number between 5 and 8 inclusive appeared, they were paid for a risk preference task. Where a '5' represents choice of risk preferences 'task 1' and '8' is choice of risk preferences 'task 4'. The subjects tossed a 10-sided dice to select one row from the task or game chosen. Subjects were paid the actual amount of money depicted in the row chosen according to the instructions of the task. The use of money incentives restricts subjects to making choices on one good (G. W. Harrison et al., 2005). All the subjects received 50 rands participation fee.

The students completed a questionnaire, which required their personal characteristics and financial literacy information and wrote a 30-questions test on financial literacy. Test questions on financial literacy were adopted from Jumpstart, Dollar sense, Knowledge Assessment Survey Questions and National Financial Capability Study (NFCS) (Lusardi & Mitchell, 2011; LaBorde et al., 2013; Mandell, 2008). The participant with the highest score in the test was rewarded a money prize of R200. Participants were informed of the R200 prize money before they participated in the experiment.

The research enlisted the services of two research assistants who distributed the document that included experimental tasks, questionnaire and a financial literacy test. The test was written under examination conditions, with the research assistants invigilating the test to prohibit copying and discussion of answers by the participants. The subjects filled in a consent form, which indicated that participation in the study was voluntary. Instructions on how to play time preference games were read first and the subjects played a demo game before playing the actual tasks. The games had written instructions included in the document and for clarity, the researcher read them first before the participants completed the tasks. Subjects also completed the personal information questionnaire. Participants were informed of their right to withdraw from the experiment at any point they wanted to.

## **Measuring time preferences**

Our study used MPL time preferences with two lotteries A and B where Option A represented impatient behaviour shown by choosing a small sooner (SS) choice and Option B represented patience signified by choosing larger later (LL) choice (Harrison et al., 2015; Andersen et al., 2008). Each MPL game had ten decision rows with binary choice options A or B and subjects

had an option of choosing Small Sooner (SS) choice or Larger Later (LL) choice (see Table 1). Each subject made 40 different choices of time preferences from four time preference tasks.

Table 1: Typical payoff matrix for the time preference experiments

	Lottery A	Lottery B	Choose A or B
row	Payment in one week	Payment in one month and one week	
1	R250	R250+ 10% interest=R252.09	A B
2	R250	R250 +20% interest=R254.20	A B
3	R250	R250+30% interest=R256.33	A B
4	R250	R250+40% interest=R258.47	A B
5	R250	R250+50% interest=R260.63	A B
6	R250	R250+60% interest=R262.81	A B
7	R250	R250+70% interest=R265.00	A B
8	R250	R250+80% interest=R267.22	A B
9	R250	R250+90% interest=R269.45	A B
10	R250	R250+90% interest=R271.70	A B

The design of the four MPL time preference task are shown in Table 1. Table 1/ task 1, subjects were asked to make a choice to receive R250 in one week ( $t=0$ ) or R254.20 in one month and one week ( $\tau =1$ ). Task 2, subjects were asked in row 1 to make a choice to receive R250 in one week ( $t=0$ ) or R256.33 in three months and one week ( $\tau =3$ ). Task 3, subjects were asked in row 1 to make a choice to receive R250 in one week ( $t=0$ ) or R262.82 in six months and one week ( $\tau =6$ ) and Task 4, subjects were asked in row 1, to make a choice to receive R250 in one week ( $t=0$ ) or R276.29 in one year and one week ( $\tau =12$ ). The interest for the future period (larger Later) ranged from 10% in row 1 up to 100% in row 10 (see, Table 1). In short the individual discount rates IDR given as  $IDR_{(t, \tau)}$  where (t) is present time choice SS paid in a week in case of our experiment and  $\tau$  is future time delivery LL in our case given as 1 month, 3months,6months and 12 months.

### Measuring risk preferences

Table 2 : Typical payoff matrix for the risk aversion experiments

row	Lottery A				Lottery B				EV <sub>A</sub> in rands	EV <sub>B</sub> in rands	Difference in rands
	p	Rands	p	Rands	p	Rands	p	Rands			
1	0.1	60	0.9	50	0.1	100	0.9	25	51	32.5	18.5
2	0.2	60	0.8	50	0.2	100	0.8	25	52	40	12
3	0.3	60	0.7	50	0.3	100	0.7	25	53	47.5	5.5
4	0.4	60	0.6	50	0.4	100	0.6	25	54	55	-1
5	0.5	60	0.5	50	0.5	100	0.5	25	55	62.5	-7.5
6	0.6	60	0.4	50	0.6	100	0.4	25	56	70	-14
7	0.7	60	0.3	50	0.7	100	0.3	25	57	77.5	-20.5
8	0.8	60	0.2	50	0.8	100	0.2	25	58	85	-27
9	0.9	60	0.1	50	0.9	100	0.1	25	59	92.5	-33.5
10	1	60	0	50	1	100	0	25	60	100	-40

The students also completed four risk preference tasks. The subjects had an option of either choosing one row for either lottery A or lottery B. Choosing lottery B in row 1 shows a high degree of risk loving/seeking attitude while choosing lottery A in row 10 is a reflection of high degree of risk aversion attitude. The four risk aversion tasks have four different prizes that appears follows; task/game 1 (A1: 60 rands, 50 rands; B1: 100 rands, 25 rands) (Table 2). Task/game 2 (A1:70 rands, 45 rands; B1: 110 rands, 10 rands), task/game 3 (A1: 200 rands, 120 rands; B1: 300 rands, 50 rands), task/game 4 (A1: 250 rands, 150 rands; B1: 400 rands, 10 rands). The probabilities of winning in the tasks were the same for all tasks (Table 2). The use of MPL risk and time preference games in our study allowed subjects to make a single decision on two lotteries (Andersen et al., 2008; Holt & Laury, 2002). In the study, university students provided their preference over two lotteries at a given time and rationally they should prefer a lottery that has a higher expected value. At the time of the experiment, the exchange rate was at 1USD: 12.99 rands and the prizes won ranged between USD 1.54 (20 rands) to USD30.80 (400 rands).

### Payment of prizes

The participation fee and the risk-preference game winners received their pay off on the day of the experiments. *E-wallet* money transfer was used to pay-off subjects beyond the day the experiment was carried as prescribed by the instructions in the games. *E-wallet* is an online banking system used by a South African financial institution. Payment of money was through mobile phone numbers and the receiver did not incur costs of withdrawing the money from the bank when using *e-wallet* in South Africa. All subjects provided their phone numbers on the payment forms, which made it possible to send the prizes won. All time preferences winners were paid after a week to deal with present time bias and according to game instructions (Harrison et al., 2004; Alan & Ertac, 2015).

### Methodology

The research analysed a set of descriptive statistics and ran an Ordinary Least (OLS) Regression analysis. The study specified an OLS regression model to investigate the relationship between financial literacy and decisiveness in making time preference and risk preference choices shown in (equation 1):

$$FL = \alpha + \beta_1 D + \beta_2 R + \beta_3 X + \varepsilon \quad (1)$$

Where *FL* is the financial literacy score, *D* is a dummy variable for multiple switching or indecisiveness (represented as variable SwitchIDR, Table 6) in the time preference binary choice tasks that is coded '1' if an individual multiple switch on binary choices and '0' otherwise (Table1) and *R* is a dummy variable for multiple switching or indecisiveness (represented as variable SwitchR, Table 6) in the risk preference tasks that is coded '1' if an individual multiple switch on binary lotteries and '0' otherwise (Table 2). Variable *X* stands for personal characteristics or control variable ranging from gender, age, race, geographical location, marital status, income, financial decision status, degree enrolled in, impatience and risk aversion. The variable  $\varepsilon$  is an error term that is assumed to be random and normally distributed.

Rational choice involves making choices of dominated lotteries that are complete and transitive (Danan et al., 2012). If a decision maker discards all dominated lotteries for un-dominated

lotteries they become indecisiveness between binary lotteries A or B. Indecisiveness is a sign which shows that an individual is failing to rank lotteries due to information imperfection or lack of information. Individuals may fail to rank lotteries leading them to multiple switch between binary lotteries A or B which is a sign of indecisiveness. The study investigated if multiple switching across binary lotteries is associated with an individual's level of financial literacy.

## Results and findings

Of the 192 university students that participated in the study, about 53% of the subjects were female. A maximum of 7 680 risk preference and 7680 time preference choices were collected from the university students and analysed. The average score in the financial literacy test was 40%, showing low levels of financial literacy amongst university students. The lowest and the highest marks scored in the financial literacy test were 3% and 80% respectively. The paper recorded multiple switching on risk preference (switchR, Table 6) and time preferences (switchIDR, Table 6) with a dummy variable '1' multiple switching '0' otherwise. The research also recorded the safe risk preference choices (risk aversion) and impatient time preference choices (impatient) by summing the number of lottery A choices made by an individual in the tasks Table 1 & 2.

The study asked the subjects to give the estimate of the amount of money they spend per month in questionnaire. The average income spend in a month by each subject was R1543. The average age of the participants was 22.3 years, with the oldest participant being 44years and the youngest 18 years old.

Table 3: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
female	192	0.53	0.4993	0	1
age	192	22.28	3.2346	18	44
income	192	1543.49	1189.03	500	10000
literacy	192	40.00	16.32	3.3	80

Another variable used in the analysis is financial decision-making status. The study asked students a question, which required them to indicate if they made financial decision on their own, made financial decision jointly with somebody or they were non-financial decision makers. Students also indicated the geographical location, where they lived when they are not at university. Sixty-nine percent of the students reported that they lived in urban areas while 31% resided in the rural areas.

## Time preferences choices and financial literacy level

The study recorded all choices made by the subjects for all the time preferences tasks. If a subject chose option A it was coded choice '1' and if the subject chose option B the choice was coded '0'. The research split the subjects by their financial literacy level. Subjects that scored a mark below average in the financial literacy test were categorised as low financial literacy group while subjects that scored a mark above average were classified as high financial literacy group. An average mark in a test reflect the mean score of the subjects in an assessment. It can be used as reference point of the general performance of the whole group (Hilmer & Hilmer, 2014).

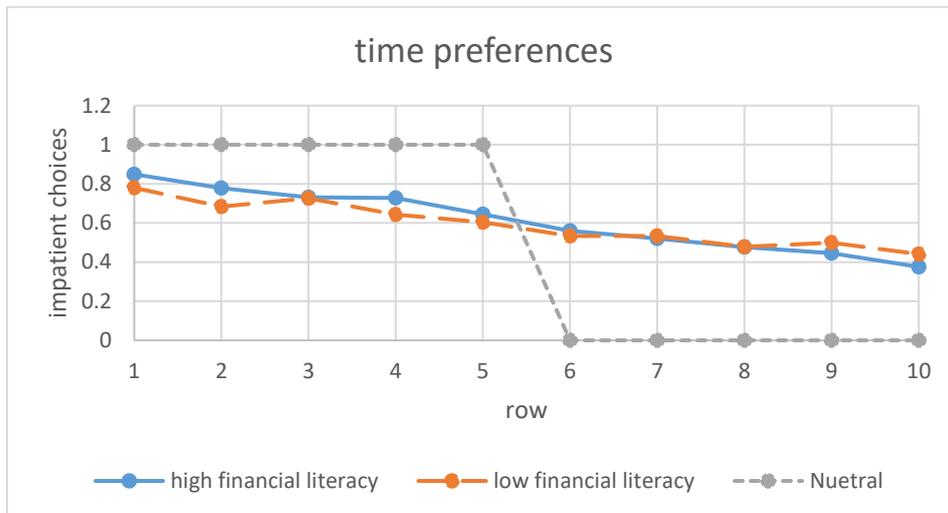


Figure 1: Time preferences choices for all tasks

All the 192 students made 7680 (time preference) choices. The 7680 choices for all time preferences tasks are represented as a fraction in Figure 1. The study recorded the proportion of impatient choices selected by all subjects. If all participants would choose lottery A in row 1, the proportion of choices made will 100% which is equal to 1 (Figure 1). An individual who is neither patient nor impatient is expected to trace the ‘neutral’ curve. In all the tasks played, individuals with higher financial literacy were generally more impatient at low stakes of the lottery with the maximum proportion of impatient choices of about 90% selected in row 1 compared to 80% of low financial literacy group. High financial literacy students were more patient than low financial literacy at higher prize stakes, although the variation in patience attitude is not significant (Figure 1).

### Risk preferences choices and literacy level

The paper recorded a maximum of 7680 risk preference choices from selections made by 192 students. All choices for option A in all the risk preference lotteries task played were coded ‘1’ and all choices for option B are coded ‘0’. Choosing option ‘A’ in row 1 is selecting a safe lottery and the study recorded proportion of safe choices made by subjects categorised by financial literacy.

Figure 2 shows that subjects with high financial literacy were more risk averse when compared with low financial literacy subjects, although the variation in risk attitudes is not significant. Ninety percent of students with high financial literacy chose lottery A in row 1 for all tasks completed compared to 70% of the subjects with low financial literacy. High financial literacy subjects are more likely to trace the predicted safe choices when compared to low financial literacy subjects. The ‘predicted’ curve shows the choices a risk neutral individual will make in the risk preference task.

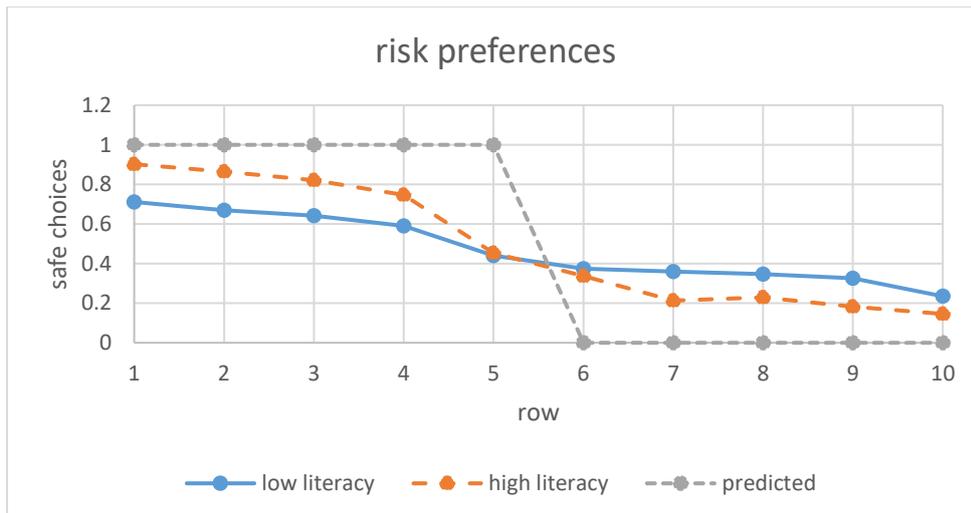


Figure 2: risk preferences choices for all tasks

### Multiple switching between binary lotteries

Measuring risk preferences using MPL procedure has its own challenges and advantages (Frederick, 2005; Harrison et al., 2005). Measuring individual level of risk aversion is only possible if the subject exhibits a unique switching point on the given binary choices. Multiple switching on option A or B in the tasks played is a sign of indifference or indecisiveness. The study split the subjects across financial literacy level and arranged the games according to the size of the prizes they offered, where task 1 had a low prize and game 4 had the highest prize (Table 4).

Looking at all the four risk preferences games played, an average of 43% all the participants, 49 % of subjects with low financial literacy and 34% of subjects with high financial literacy exhibited multiple switching across the binary lottery choices A or B. On average 45% of male subjects multiple switched between binary lotteries A or B. A higher number of males with low financial literacy (49%) exhibited the multiple switching trait. A lower number of males with high financial literacy (37%) multiple switched between the binary lotteries. On average 41% of all females, 48% of females with low financial literacy and 31% of females with high financial literacy switched multiple times that is, more than once between the lottery A or B. In all cases, that is, for all tasks 1 to 4, subjects with low financial literacy exhibited a higher percentage of multiple switching compared to their counterparts with high financial literacy. In game 4, male subjects with high and low financial literacy had the same percentage of multiple switching (47%), showing that as the prize became larger indecision between binary lotteries increased for all male subjects.

Moving on to all the four combined time preferences games played, 34% of all participants in the study exhibited multiple switching across the binary choices. Comparing the subjects by financial literacy level, subjects with low financial literacy had an average of 40% multiple switching, whereas subjects with higher levels of financial literacy had an average of 26% multiple switching. This shows that use of MPL method to elicit time preferences and risk preferences is more suitable for people with high literacy. A higher percentage of multiple switching by lower financial literacy shows that university students who lack financial literacy are more likely to face indecision in making preference choices.

Table 4: Percentage of multiple switching subjects in the risk preference tasks.

<b>Task</b>	<b>subjects</b>	<b>Average multiple Switching %</b>	<b>Low fin literacy Multiple switching</b>	<b>High fin Literacy Multiple switching</b>
Composite all games played	All	43%	49%	34%
	male	45%	49%	37%
	female	41%	48%	31%
Task/Game 1- Table E	All	41%	50%	27%
	male	44%	49%	34%
	female	38%	51%	23%
Task/Game 2- Table F	All	43%	49%	34%
	male	44%	52%	30%
	female	41%	45%	36%
Task/Game 3- Table H	All	42%	49%	39%
	male	45%	48%	40%
	female	39%	44%	32%
Task/Game 4- Table G	All	45%	47%	43%
	male	47%	47%	47%
	female	43%	50%	34%

This shown by indifference or indecisiveness in making choices on binary lotteries. Indifference shows indecisiveness in making risk preferences and time preferences choices. If this behaviour is true in the practical world, low financial literacy subjects will fail to optimize return from their preference choices. University students with low financial literacy trembled more than those with high financial literacy when they are asked to make binary choices. There was a higher percentage of multiple switching on lotteries for the risk preferences tasks when compared to time preferences tasks, which suggests that indifference or indecisiveness is higher when individuals make choices on risk tasks. It also shows that a risk preference task requires higher cognitive ability to complete (Andersen et al., 2008). Andersen et al. (2008) also pointed out that the risk preference behavioural error, that is, ‘structural error’ between lotteries is larger for risk preference tasks than for time preferences tasks.

Table 5: Percentage of multiple switching subjects in the time preference tasks.

<b>Task</b>	<b>subjects</b>	<b>Average multiple Switching %</b>	<b>Low fin literacy Multiple switching</b>	<b>High fin Literacy Multiple switching</b>
Composite all games played	All	34%	40%	26%
	male	34%	37%	27%
	female	34%	42%	25%
Task/Game 1- Table A	All	34%	39%	27%
	male	36%	40%	29%
	female	33%	39%	26%
Task/Game 2- Table B	All	31%	38%	20%
	male	30%	34%	23%
	female	32%	43%	18%
Task/Game 3- Table C	All	36%	40%	31%
	male	33%	35%	29%
	female	39%	44%	32%
Task/Game 4- Table D	All	35%	42%	26%
	male	36%	40%	29%
	female	35%	44%	23%

Our findings are quite insightful. Lower financial literacy is highly associated with a higher percentage of indifference or indecisiveness between the binary lotteries. The results are not unique, other studies have also concluded a high number of subjects making mistakes in binary choices tasks. Jacobson and Petrie (2009) in an experimental study with Rwanda adult population found that 50% of the subjects that participated in the study made at least one mistake in their choices. In the study, multiple switching between lottery A or B is treated as indecisiveness in making preference choices, although a number of studies have equated the action to indifference between lottery A or B (Meier and Sprenger, 2013; Harrison et al., 2005).

### **Financial literacy and indifference or indecisiveness on binary lotteries**

An ordinary least squares (OLS) regression analysis for all subjects without controlling for personal characteristics shows that multiple switching between time preference and risk preference tasks significantly increases with low levels of financial literacy (Table 6, column 2 'All'). The coefficient of multiple switching on binary lotteries for the time preference tasks is (-1.63) and it is significant at 1% level. Students with low level of financial literacy are indecisive in making time preference choices. In addition, the coefficient of multiple switching on binary lotteries of risk preferences is (-2.03) and it is significant at 1% level. The findings reveal that university students with low financial literacy are more likely to be indecisive when making risk preference choices. Indecision in making choices might result in subjects making suboptimal and inconsistent choices that might not maximize their utility and benefits. There is evidence that suggest that financial literacy education is only beneficial to people who lack it (Lusardi & Mitchell, 2007).

Becchetti et al (2013) observed that financial literacy education is helpful to those with low levels of financial literacy, revealing that providing financial literacy to individuals will reduce indecisiveness and commission of financial errors. There is research evidence that confirm that committing mistakes reduces benefits from choices. Jacobson and Petrie (2009) found out that subjects more likely to make mistakes were less likely to belong to savings group, as they were more risk averse. Prasad and salmon (2013) in their experiment found out that subjects that make inconsistent choices are more likely to earn low rewards. The research findings confirm that university students with low levels of financial literacy are more likely to make suboptimal choices. As they multiple switch across lotteries, they switch between lotteries with higher and low expected return vice-versa. Risk aversion for all subjects significantly increases with high levels of financial literacy at 5% level while impatience significantly increases at 10% level as financial literacy decreases. Research results from other studies on risk aversion and impatience are mixed. People with low IQ were found to be impatient and risk averse (Dohmen et al., 2010). Another study found a strong correlation between risk aversion and cognitive ability (S Huck & Weizsäcker, 1999). The variation in the results may be due to framing effects of the experiments used in the studies.

Moving on to female university students, multiple switching on time preferences 'switchIDR' significantly increases at 1% level as financial literacy decreases. Impatience for female university students increases at 1% level of significance as financial literacy increases. Multiple switching on risk preferences lotteries 'switchR' for female university students significantly increases at 1% level as financial literacy decreases.

Table 6 : OLS Regression: Financial literacy, indifference on lotteries and determinants

determinants	All	female	male	High literacy	Low literacy	
switchIDR	-1.45*** (0.103)	-1.63*** (0.106)	-2.17*** (0.139)	-1.06*** (0.160)	-0.79*** (0.122)	-0.25*** (0.071)
impatient	0.033** (0.013)	-0.027* (0.014)	0.070*** (0.021)	-0.14*** (0.017)	-0.023 (0.015)	-0.11*** (0.008)
switchR	-1.36*** (0.101)	-2.03*** (0.106)	-2.38*** (0.145)	-1.45*** (0.152)	-0.85*** (0.111)	-0.62*** (0.067)
Risk aversion	0.076*** (0.017)	0.039** (0.018)	0.12*** (0.027)	-0.089*** (0.023)	-0.023 (0.022)	-0.070*** (0.010)
female	0.59*** (0.080)					
age	-0.066*** (0.013)					
African	3.10*** (0.162)					
Asian	-1.17*** (0.261)					
colored	5.28*** (0.306)					
urban	1.26*** (0.085)					
single	3.57*** (0.141)					
divorced	2.64*** (0.146)					
investment_deg	-0.97*** (0.107)					
Law_deg	11.3*** (0.174)					
Admin_deg	-1.63*** (0.119)					
Accounting_deg	1.87*** (0.420)					
interpre_deg	5.20*** (0.300)					
Marketing_deg	-3.99*** (0.259)					
Mgnt_deg	-1.07*** (0.203)					
Hrm_deg	1.55*** (0.193)					
Non_decision	-2.09*** (0.108)					
Joint_decision	-2.14*** (0.099)					
income	0.0000027 (0.000)					
constant	7.70*** (0.422)	12.7*** (0.086)	12.9*** (0.131)	12.5*** (0.111)	17.3*** (0.099)	8.87*** (0.046)
N	13909	15341	8079	7262	6144	8008
R <sup>2</sup>	0.279	0.033	0.053	0.022	0.014	0.026

Standard errors in parentheses \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

On the other hand, risk aversion for female respondents significantly increases at 1% level as financial literacy increases. In the same vein, male respondents' indecisiveness or multiple switching on time preference lotteries significantly increases at 1% level as financial literacy decreases. Impatience among male university students significantly increases at 1% level as financial literacy decreases. Similarly, indecisiveness on risk preference lotteries for male university students significantly increases at 1% level as financial literacy decreases. The OLS results show that risk aversion in male participants significantly increases at 1% level as financial literacy decreases.

The study classified participants with a financial literacy test score above average as high financial literacy group while those with a test score below average were categorised as low financial literacy group. Indecisiveness on time preference lotteries by students with high financial literacy significantly increased at 1% level as financial literacy of the students decreases. In addition, indecisiveness on risk preference binary lotteries by university students with high financial literacy significantly increased at 1% level as their financial literacy decreases. Impatience and risk aversion is not significantly associated with financial literacy of university students with high financial literacy. The results show that financial literacy reduces risk aversion and impatience among university students. Indecisiveness on time preference lotteries by university students with low financial literacy significantly increases at 1% level as financial literacy decreases, showing that students with lower levels of financial literacy are more likely to be undecided when making preference choices. Further, impatience of university students with low financial literacy significantly increases at lower levels of financial literacy. Multiple switching on risk preference lotteries by university students with low financial literacy significantly increases at 1% level as financial literacy decreases. Finally, risk aversion for university students with low financial literacy significantly increases at 1% level at low levels of financial literacy.

The study included other student characteristics to investigate variables that are significantly associated with financial literacy in university students (Table 6, Column 1 'determinants'). Indecisiveness on time preference and risk preference lotteries by university students significantly increases at 1% level as the level of financial literacy decreases. Again confirming that students with lower levels of financial literacy are more likely to be indecisive when making risk and time preferences choices. Impatience and risk aversion of university students significantly increases with higher levels of financial literacy. Female university students were more likely to have high financial literacy at 1% level of significance. As age increases, university students were more likely to have significantly low financial literacy at 1% level. Belonging to the race African and Colored were significantly associated with high financial literacy while being Asian is significantly associated with low level of financial literacy at 1% level.

Geographical location of university students is significantly associated with their financial literacy. Students residing in urban centres are more likely to have significantly high financial literacy at 1% level when compared to those from rural areas. Single and divorced students were more likely to have significantly high financial literacy at 1% level. The research examined the degree programs that are associated with high or low levels of financial literacy. Students enrolled in the investment degree, public administration degree, marketing degree and bachelor of commerce degree were more likely to have significantly low levels of financial literacy at 1% level. On the other hand, students pursuing bachelor of commerce law, accounting, entrepreneurship or industrial psychology degrees were more likely to hold significantly high levels of financial literacy at 1%.

The study explored the relationship between financial decision status and financial literacy. Given that a student is a financial decision maker, university students who are non-financial decision makers or joint financial decision makers were more likely to hold significantly low level of financial literacy at 1% level. The results show that actively participating in financial decision-making increase financial knowledge among university students. Van Rooij, Lusardi & Alessie (2011) found out that individuals who invested on the stock market had higher levels of financial literacy when compared to those that did not participate on the market. The study did not find significant effect of income on financial literacy.

## **Conclusion**

The study used an OLS analysis to examine the impact of financial literacy on decisiveness on making risk preference and time preference choices by university students. The risk preferences and time preferences were elicited using multiple price list incentivized experimental method. The paper split the subjects according to their financial literacy level where students that scored a financial literacy test mark above average were categorised as high financial literacy while those who scored a mark below average were classified as low financial literacy group. The study explored the relationship between indecisiveness, impatience and risk aversion of university students and their financial literacy.

The research results show that indecisiveness increases as levels of financial literacy decreases in all cases investigated. The results reveal that university students with low financial literacy struggle to make decisive risk preference and time preference choices. Low financial literacy students are more likely to multiple switch when completing multiple price list risk preference and time preference tasks. The findings reveal that students with lower levels of financial literacy are more likely to treat dominated risk preference and time preference lotteries as undominated lotteries. They are more likely to be unable to rank lotteries according to the size of expected value. Inconsistency in making risk preference and time preference choices might lead to individuals making sub-optimal choices resulting in achieving poor financial outcomes. The study findings confirm the importance of providing financial literacy. Providing financial education to university students will increase decisiveness in making intertemporal and risk choices.

On the other hand, the relationship between impatience, risk aversion and financial literacy is mixed. Impatience for the total group, male students and low financial literacy respondents increases with low levels of financial literacy. Impatience in female respondents increases with high levels of financial literacy. Further, risk aversion for all respondents and females increases with high levels of financial literacy. The risk aversion for male students and low financial literacy respondents increases as financial literacy decreases. These results show that impatience and risk aversion differ from one group to another.

The following groups of individuals were associated with low levels of financial literacy namely; university students who engaged in multiple switching on lotteries (indecisive), older students, Asians, students from rural areas, students enrolled in the following degrees (investment, public administration, marketing and bachelor of commerce), non-financial decision-makers and joint financial decision makers. Targeting financial literacy on these groups of students might improve decisiveness in their risk preference and time preference choices.

This is the first study in South Africa to investigate the relationship between financial literacy and decisiveness in making risk preference and time preference by university students using multiple price list incentivized experiment method. The paper shows in an experimental setting that university students with lower financial literacy have difficulties in making risk preference and time preferences choices revealed by multiple switching over lotteries. If these findings can be confirmed with other studies, this will go a long way in explaining why people with low financial literacy do not generally achieve better financial life outcomes.

Our research has its own set of limitations. University students studying an undergraduate commercial degrees' financial literacy levels cannot be representative of the financial literacy levels of the South African population. Comparing the results of our findings with the total population of South Africa might not portray a true picture. It is also difficult to tell whether incentivized risk preference and time preferences rewards can elicit the true attitudes of individuals. However, this study provides a starting point to carry further research with a representative population of South Africa using the methodology and tools applied in the research.

Setting aside these limitations, our study provides an outline on ways to analyse the relationship between financial literacy and decisiveness in making risk preference and time preference choices by young adults enrolled in university. Further studies can focus on investigating the impact of financial literacy on decisiveness in making risk preference and time preference choices particularly on a representative South African population. Confirmation of these results in other studies can help researchers to have a deeper understanding on how financial literacy influence preferences.

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## **Compliance with Ethical Standards**

### **Conflict of interest**

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### **Ethical Approval**

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Permission to carry out the study was granted by the University of the Free State Ethics Committee (Number: UFS-HSD2016/0079).

### **Informed Consent**

Informed consent was obtained from all individual participants included in the study.

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