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Fitzsimmons, J.R. and Davidsson, P. (2006) Entrepreneurs and Intertemporal Decision Making. In *Proceedings BCERC Conference*, Bloomington, Indiana, U.S.A.

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Fitzsimmons, J.R. and Davidsson, P., (2006). "Entrepreneurs and Intertemporal Decision Making", BCERC 2006, Bloomington, Indiana, U.S.A., June 2006.

## ENTREPRENEURS AND INTERTEMPORAL DECISION MAKING

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### ABSTRACT

This paper investigates the decision making behaviour of individuals with respect to attributes considered relevant to the assessment of potential venture opportunities. Using a decision making experiment, we were able to consider the behaviour of individuals taking into account their risk and time preferences. We find that while the respondent as a whole placed most weight on the potential payoffs when considering the value of a venture opportunity, we find significant individual differences in preference weightings across the attributes used in the study. By using a series of hypothetical venture vignettes, we also find some evidence that these differences in preference weightings may be useful in predicting choice behaviour in a more realistic entrepreneurial environment.

### INTRODUCTION

Making decisions in the face of risk and uncertainty is a key task in entrepreneurship. Individuals considering undertaking a new venture must evaluate the worth of a perceived opportunity and invest funds in the present for the chance of receiving uncertain future profits. These uncertain future profits involve not only a subjective assessment of the magnitude of the potential cashflows from the venture but also the probability of receiving those uncertain cashflows and the time period before these returns will be realised. From an entrepreneurship perspective the situation is all the more difficult given that it is not an easy task to estimate the probabilities of various outcomes and the returns to be realized in order to arrive at a subjective value (March and Shapira, 1987).

Assessing the potential value of a new venture opportunity, then, involves making judgements about payoffs that are both risky and delayed. While risk and delay appear to be separate concepts, there are a number of parallels between the biases individuals make when making risky decisions and where delayed outcomes are involved (Weber and Chapman, 2005). Risky decisions are those that involve future outcomes, and delayed outcomes are considered more risky as the delay increases. How individuals assess the value of venture opportunities in such circumstances is not well understood. In this paper we investigate how individuals arrive at subjective valuations when both risk and delay are involved.

Baron and Ward (2004) suggest decision making experiments could be used to investigate such decision making behaviour, with the extent to which individuals use specific strategies uncovered by noting the information they use in making their decisions. A cognitive approach may be useful,

particularly since the greater uncertainties associated with entrepreneurial environments may lead to cognitive errors (Baron, 1998). This may be particularly relevant given a significant amount of research that has uncovered a range of cognitive biases and errors such as overconfidence, optimism, the planning fallacy, the illusion of control that may impact on the decision making processes of entrepreneurs (Baron, 1998; e.g. Busenitz and Barney, 1997; Keh, Foo and Lim, 2002; Simon, Houghton and Aquino, 1999).

It has been suggested that entrepreneurs may not differ in risk propensities or risk tolerance but instead have a general tendency to perceive risky situations more optimistically than other individuals (e.g. Busenitz and Barney, 1997; Palich and Bagby, 1995). The risk issue is further complicated by the temporal element which adds to the complexity of entrepreneurial decision making and is an element that should be considered in understanding the full range of entrepreneurial behaviour (Das and Teng, 1998). As noted by Lopes (1996), it is generally agreed that time plays a crucial role in risk and risk behaviour, and since risk and uncertainty are essentially about unpredictable futures, they involve the dimension of time (Das and Teng, 1998). In addition, significant anomalies have also been found in the decision making behaviour involving delayed outcomes. While economic theory would suggest that individuals discount future streams of money at a constant discount rate, empirical research has shown implied discount rates tend to decrease as the time period increases and also decline as the dollar amounts increase (Thaler, 1981). These anomalies could have significant impact on entrepreneurial decision making, with differences in the time-span of risk having profound impact on how risky alternatives are valued (Das and Teng, 1998). Furthermore, if certain individuals are susceptible to cognitive biases such as the planning fallacy then the problem might be exacerbated if these individuals have a general tendency to underestimate the time taken to complete a task or in the entrepreneurial situation, to underestimate the time period before the rewards from a venture can be received.

In this paper, we extend the cognitive perspective and investigate the decision making behaviour of individuals taking into account their *risk* and *time* preferences. Specifically, we are interested in understanding the valuation behaviour of individuals in decision making experiments involving delayed probabilistic outcomes where individuals must make decisions involving risky alternatives with future consequences. Investment decisions, for example, require subjective evaluations of uncertain future profits to be weighed against present expenditures (Ahlbrecht and Weber, 1997). How individuals make choices and evaluations under these conditions has received considerable attention in the decision making literature. Given the parallels of risky intertemporal choice to the decisions entrepreneurs must make when evaluating ventures our aim in this paper is to investigate how this behaviour translates into the entrepreneurship domain. In doing so, we aim to explore the following issues: firstly, to what extent do individuals use the attributes of returns, probabilities and delay in valuing venture opportunities, secondly, can this information be used to predict choice behaviour in more realistic entrepreneurial settings and finally, are there individual level factors that might influence valuation behaviour.

## THEORY

### The Discounted Utility Model

The expected utility and discounted utility models provide the basis for a normative theory of decision making involving uncertainty and time with both models assuming individuals make decisions based on a weighted sum of utilities (probabilities or time respectively). A natural extension of these models is the discounted expected utility model (DEU) where for a single risky future outcome the individuals' utility is given by:

$$U(X) = \delta^t \cdot p \cdot u(x)$$

where  $U(X)$  is the utility associated with the prospect,  $p$  is the probability and  $\delta$  is the discount factor. For exponential discounting the relationship between the discount factor and the discount rate  $r$  is given by  $\delta = 1/(1+r)^t$ .

Despite the appeal of the discounted expected utility model as a theory of decision making, the model is restrictive in terms of the specification of the attribute weighting (Prelec and Loewenstein, 1991). The model also assumes that the effects of outcomes, probabilities and time are separable, with risky prospects being linear in probabilities and for temporal prospects being exponential in time. However, there are reasons to believe that the relationship between risky outcomes and delayed outcomes is more closely related (Weber and Chapman, 2005). Rachlin, Raineri and Cross (1991) suggest that delay is the fundamental factor with the effect of uncertainty on choice being due to delay, since in repeated gambles, a higher risk translates into a longer delay until the decision maker can expect a payoff. On the other hand, Keren and Roelofsma (1995) argue that uncertainty is the more fundamental of the two, since delaying outcomes tends to increase uncertainty. Their research suggests that risk and delay produce the same phenomena with risk being the more psychological fundamental construct, with delay effects actually being the effects of the risk associated with delayed outcomes (Weber and Chapman, 2005).

### Empirical anomalies

Despite the wide applicability of the discounted utility model, a number of anomalies have been documented both in respect of expected utility and discounted utility. Preferences between risky prospects should not be affected by multiplying the probabilities of non-zero outcomes by a common factor, however the *common ratio effect* violates this prediction (Kahneman and Tversky, 1979). In this case for example, an individual who is indifferent between a 25% chance of \$2500 and a 50% chance of \$1000 would probably prefer a 2.5% chance of winning \$2500 to a 5% chance of winning \$1000. The corresponding anomaly in intertemporal choice is the *common difference effect* (Prelec and Loewenstein, 1991). While the discounted utility model suggests that an individual's preference between two single outcome temporal prospects should depend only on the absolute time interval between outcomes, experimental evidence has found that the impact of a constant time difference between two outcomes becomes less significant as both outcomes become more remote (Prelec and Loewenstein, 1991). As an example, a person who prefers \$100 in one year to \$200 in two years would most probably prefer \$200 in eleven years to \$100 in ten years.

Another closely related pair of anomalies is the certainty effect and the immediacy effect. The certainty effect describes a decision-makers tendency to place a disproportionate weight on certain outcomes compared to risky outcomes. For example, in a choice between \$30 for sure and \$45 with 80% probability, most individuals tend to prefer the \$30 for sure. Kahneman and Tversky (1979) explained this phenomenon descriptively through the introduction of a non-linear probability weighting function ( $\pi$ ) which is concave for higher values of probability and increases very rapidly near certainty. For near certain outcomes, small deviations from certainty can have a large influence on the decision making process (Weber and Chapman, 2005).

The immediacy effect describes the behaviour of decision makers in placing a disproportionate weight on immediate outcomes. As an example, individuals might prefer \$100 now to \$200 in one year, but might also prefer \$200 in two years to \$100 in one year. This behaviour would not be expected under exponential discounting, since if a decision maker prefers one delayed option to be preferred now, that option should also be preferred at every point in the future as well. While the exponential discounting model assumes that individuals have a constant discount rate over time, empirical evidence has shown that discount rates tend to decline over time. This declining rate of time preference has been referred to as hyperbolic discounting (Ainslie, 1975). When subjects are asked to compare a smaller-sooner reward to a larger-later reward, the implicit discount rate over longer time periods is lower than the implicit discount rate over shorter time periods. One of the earliest examples was the research by Thaler (1981) where

subjects to asked specify the amount of money they would require at a later time period to make them indifferent to receiving a certain amount of money in the present. The median responses obtained implied average (annual) discount rates of up to several hundred percent and declining over longer time periods. Since the hyperbolic function is steepest very near immediacy, decision biases connected to the hyperbolic function are largest when one of the choices involves an immediate payoff (Weber and Chapman, 2005)

#### Comparisons to New Venture Valuation

While the models outlined above were developed to describe decision making behaviour of individuals making assessments of risky delayed outcomes, the models have strong parallels to the actual decision making behaviour associated with entrepreneurial behaviour. Entrepreneurs considering a venture must consider the value of the venture. For a venture involving an upfront commitment of capital and payoffs consisting of period free cashflows ( $FCF_i$ ) and an exit or horizon value ( $V_H$ ), the present value ( $PV$ ) of the venture is given by:

$$PV = \sum_{i=1}^H \frac{FCF_i}{(1+r)^i} + \frac{V_H}{(1+r)^t}$$

where  $r$  is the discount rate.

Given that few dividends are paid in most new ventures, as an approximation the present value of the venture is predominantly contained in the horizon value:

$$PV = \frac{V_H}{(1+r)^t}$$

If the horizon value could be considered as a single future cashflow ( $C_1$ ) that is to be contained with certainty, then the present value of the venture is given by:

$$PV = \frac{C_1}{(1+r_f)^t}$$

where  $r_f$  is the risk free rate.

However, if the cashflow is risky, we can discount the forecasted (expected) value of the horizon value at a risk-adjusted discount rate ( $r$ ), which is typically larger than the risk free rate. The risk-adjusted discount rate in this case adjusts for both time and risk (Brealey, Myers, Partington and Robinson, 2003):

$$PV = \frac{E(C_1)}{(1+r)^t}$$

From an entrepreneur's perspective, the decision to pursue the venture will be dependent on the perceived value of the opportunity taking into account the magnitude of the funds needed to be expended in the present to be able to pursue the opportunity. The perceived value therefore, will be a function of the perceived probability and payoff estimates (the expected value) and the estimated time period before the payoff from the venture is to be received. The discount rate will be a function of the individuals risk and time preferences. Admittedly, the assumption of a single expected outcome is unrealistic compared

the rewards received in actual ventures. Likewise, entrepreneurial decision making is normally under conditions of uncertainty rather than risk. However, as a first approximation, the decision making behaviour of entrepreneurs considering a venture opportunity is consistent with the discounted expected utility model and behaviour observed under these conditions should offer an insight into the decision making processes in more realistic entrepreneurial settings.

### Implications for Entrepreneurial Decision Making

The role of risk in entrepreneurial behaviour has received significant attention (e.g. Busenitz and Barney, 1997; Janney and Dess, 2005; Simon, Houghton et al., 1999). However by including the intertemporal element into the analysis of decision making behaviour it should offer a better understanding of the entrepreneurial decision making and how outcomes, probabilities and time plays a role in the valuation of entrepreneurial ventures. All else being equal, we would expect an individual to prefer a venture with greater perceived payoffs. Likewise, all else being equal we would expect individuals to prefer a greater perceived probability of success and payoffs to be collected earlier than later.

If individuals were not biased in their opinions of the potential payoffs, probabilities of success and the time before the payoffs from the venture will be received, then we might expect smaller variation in the value that individuals place on a given venture opportunity than might be the case if opinions were biased. As such, cognitions should play an important role in determining the valuation and choice behaviour by individuals. Work in entrepreneurial cognition has proved valuable in understanding risk behaviour (e.g. Busenitz and Barney, 1997; Simon, Houghton et al., 1999). Busenitz and Barney (1997) suggested that entrepreneurs and managers do not differ in their levels of risk tolerance, but instead differ in their risk perceptions. Given this they are likely to approach the decision making aspect of ventures differently when making choice and valuations. Furthermore, if individuals are biased in their probability estimates then the anomalies such as the certainty effect may have significant implications for their valuations. As suggested by Baron (2004), prospect theory offers several intriguing predictions including the overweighting small probabilities and under weighting moderate and large probabilities. Individuals considering a venture might overweight the smaller probabilities (in this case the chance of success) more than others which in turn lead them to hold enhanced estimates of their own success (Baron, 2004).

Likewise, the certainty effect suggests that some individuals place a disproportionate greater weight on immediate outcomes over delayed outcomes. In the general sense, individuals who place a greater subjective weight towards earlier payoffs might choose ventures with less than ideal expected outcomes given the focus on the temporal dimension. Associated with this temporal element is the planning fallacy, where individuals have a tendency to believe they can complete tasks in a shorter time than they actually can. Baron (2004) suggested that entrepreneurial individuals are likely to be more prone to the planning fallacy than others which consequently contributes to overly confident predictions about future outcomes. As such we might expect that entrepreneurial individuals susceptible to the planning fallacy to overweight the temporal dimension when considering a potential venture opportunity.

Lastly, biases associated with the payoff dimension may influence entrepreneurial behaviour. A well known bias in this regard is the anchoring bias, where individuals place a disproportionately large emphasis on a particular attribute in the decision making process (Lichtenstein and Slovic, 1971). In evaluating a venture opportunity for example, individuals prone to the anchoring bias might place a greater weighting on the payoff dimension given that they may be anchored on the large potential payoff from the venture.

### Decision Making and Individual Level Factors

There is evidence that certain individual level characteristics are associated with the decision to engage in entrepreneurial activity (Shane, 2003). Opportunity costs in particular weigh heavily on the decision to act entrepreneurially, with those individuals with lower opportunity costs being more likely to exploit opportunities (Amit, Glosten and Muller, 1993). Gimeno, Folta, Cooper and Woo (1997) measured the relative income and education levels of entrepreneurs as proxies for their alternatives. They found entrepreneurs required greater upside potential as the value of their alternative opportunities rose. Similarly, Shane (2003) suggests that the likelihood that a person will exploit an entrepreneurial opportunity increases with the gap between the expected value of self-employment earnings and current income. As such we would expect a relationship between an individual's income and the value of potential opportunities.

## METHOD

### Sample

The sample consisted of 82 MBA students at an Australian university. The sample was spread across three classes held in the same semester (no systematic differences between group responses were found). Given that the initial decision making questionnaire took around 30 minutes to complete, it was decided to collect the data over a period of two weeks, with a decision making experiment being conducted in the first week and the data from a supplementary questionnaire being collected in the following week. We allocated the students a code in the first week so that questionnaire from the first week could be matched to respondent's questionnaire in the following week. Of the 82 students who participated in the first week's decision making questionnaire, we were able to match up 60 of these with questionnaires collected in the second week. The subjects were not paid for participation in the experiment.

### Experimental Design

The research was conducted as a decision making experiment with participants being asked to evaluate a series of risky cashflows occurring at a specified future period. The profiles were provided as new venture scenarios that varied across three dimensions being the estimated payoff from the venture, an estimated probability that the venture would be successful or unsuccessful, and the estimated time before the payoff would be received. In order to minimise potential framing effects, for half the participants the probability was specified as the probability of success while for the other half it was framed as the probability of a failure. The participants were asked to assume that the payoff from the venture would be received as a lump sum at the end of the stated period. They were also asked to presume that they had sufficient accumulated savings to participate in any investment opportunity presented.

The payoffs varied in both magnitude (4 levels from A\$1 Million to A\$10 Million) and probability of receiving that amount (4 levels from 20% to 80%). In addition, we also varied the length of time before the uncertain cashflow would be resolved (4 levels from 1 year to 10 years). Given that a full profile experiment would require the participants evaluating 64 profiles (4x4x4), we decided to conduct the experiment using a fractional factorial design with 16 orthogonal profiles. For each of the 16 profiles presented to the respondents they were indicate of the maximum amount of money that they would be prepared to pay in order to purchase 100% of the venture. The resulting data collected therefore consisted of reservations prices (willingness to pay prices) for each of the venture scenarios. The experiment also included two of warm-up tasks to get the participants used to the procedure in addition to four hold-out tasks in order to validate the responses for each participant.

The results from the decision making questionnaire were analysed using conjoint analysis with willing to pay valuations as the response variable. The resulting part worth utilities reflected the preference weights for each of the three attributes (payoffs, probabilities and time) used in the study. Summary data on the relative weightings for the group as a whole were also obtained.

## Supplementary Questionnaire

The supplementary questionnaire was designed to allow us to relate the responses from the decision making questionnaire to other individual factors relevant to entrepreneurial decision making behaviour including risk propensity and demographic information. The risk propensity items were taken from Mullins and Forlani (2005) using an adaptation of the Risk Style Scale (Schneider and Lopes, 1986). The 5 items were designed to measure personal propensities towards financial risk taking.

Of particular interest in the present study was to determine the extent to which the preference weights for the three attributes in the decision making experiment could be used to predict an individual's assessment of actual new ventures scenarios. In order to investigate this, a series of venture vignettes were prepared. These venture scenarios were designed to vary across the payoff, probability and temporal dimensions used in the decision making experiment. The scenarios were developed with each attribute varying on a high/low level resulting in 8 venture scenarios being developed (2x2x2). For each of these opportunities the respondents were asked to rate the opportunity in three ways using a scale from 1 to 7: (1) How attractive you think the opportunity is (2) How likely it is that you would pursue such an opportunity if you were faced with the opportunity within five years of graduating from the MBA program, and (3) What advice you would give to a friend who you think has the knowledge and entrepreneurial abilities to pursue such an opportunity (scaled from "definitely do not pursue the opportunity" to "definitely pursue the opportunity"). Due to the length of the supplementary questionnaire we were only able to use three of these scenarios in the final questionnaire. To minimise order effects the presentation order of the three venture scenarios was randomly varied. The venture scenarios used in the questionnaire are provided in Appendix A.

## RESULTS

### Valuations

The decision making part of the experiment asked the respondents to indicate the maximum they would be willing to pay for 100% of the equity for each of the profiles. For the analysis of the group as a whole, we used the average of the buying prices for each venture profile, consistent with previous research involving pricing tasks in decision making experiments. The results from the conjoint analysis provided us with preference weighting for each of the respondents, in addition to a summary of the relative importance weights for the group as a whole (Figure 1). By using conjoint analysis, we were able to assess the degree to which the individual respondent as well as the group as a whole placed on payoffs, probability of success and time before payoff in making their decisions. The relative importance weights for each of the three attributes were obtained by taking the difference between the highest and lowest part-worth utilities for each attribute and dividing this by the total of the differences for each of the three attributes. We find the group as a whole tended to place much more emphasis on the magnitude of the payoffs when valuing the venture prospects and least emphasis on the temporal dimension. For willingness to pay (buying) prices, we find individuals placing approximately 45% of their decision weight on the payoff dimension and approximately 30% of the decision weight on the probability of success dimension. In addition to the overall importance summaries for valuations task, we also obtained part-worth utilities for each of the attribute levels. Summary graphs of these results are shown in Appendix B. While the results provided in Appendix B are summary results for the group as a whole, it is important to note that within each subject there is a great deal of variation in preference weightings and it was this information that was used for the subsequent analysis.

[ FIGURE ONE ]

### Discounting Effects

In each of the venture scenarios in the decision making tasks the time before the payoff would be received was varied from 1 year to 10 years. By comparing the willingness to pay valuations to the

expected value of each venture scenario, the individuals implied discount rate could be determined. The implied discount rate for each task was also derived from the mean valuations for the group. Consistent with previous research, we find evidence of discount rates declining over longer time periods (Figure 2). For willingness to pay valuations the mean implied discount rates were 60.2%, 40.3%, 20.6% and 14.5% for the 1, 2, 5 and 10 year delayed payoffs respectively. We also noted the greater variation in implied discount rates for shorter time periods. From an entrepreneurship perspective, this suggests that individuals would have a tendency to apply a high discount rate to ventures that would have earlier payoffs in comparison to ventures with a longer time period before payoff.

#### Venture Vignettes

Of particular interest in this study was whether there was a relationship between the individuals' preference weights obtained from the conjoint experiment and their preference behaviour when making assessments of more realistic venture scenarios. The results for the group as a whole found Venture Y to be judged as the most attractive venture with an average rating of 3.66, followed by venture X with an average rating of 3.19 and venture Z with the lowest average rating of 3.09 (Table 1). Paired t-tests found the average rating of venture Y to be statistically greater than the ratings for venture X and Z ( $p=0.021$  and  $p=0.003$  respectively). The most significant difference between venture Y and the other ventures was the higher potential payoff in the situation where the venture was successful. Thus, consistent with the finding in the conjoint valuation task, which showed that the payoff dimension was generally the most important one, venture Y is perceived as the most attractive even though it is also characterised by high risk and a long time to payoff.

[ FIGURE TWO ]

[ TABLE ONE ]

The correlations between attractiveness ratings of the vignettes and the other variables in the study are shown in Table 2. For venture X, we found no significant relationships between preference weights and attractiveness ratings although the positive correlation coefficient for the temporal dimension would suggest that those individuals who placed a greater emphasis on the temporal dimension in general preferred venture X more. In contrast, we found several interesting relationships between preference weights and attractiveness ratings for the venture vignettes Y and Z. In considering venture Y, which was expertly judged to have a high payoff with high risk and a long period of time before returns are realised, we found relationships between the attractiveness ratings and the relative importance of the payoff dimension when buying the venture. That is, those who placed a greater emphasis on the potential return from a venture when setting buy prices liked venture Y more.

[ TABLE TWO ]

For venture Z which was expertly judged to have a low payoff with low risk and a long period of time before returns are realised, we found relationships between the attractiveness ratings and the relative importance of the payoff and probability dimensions when buying the venture. We found that individuals who placed a greater emphasis on the potential return from a venture when setting buy prices liked venture Z more. Likewise, those individuals who placed a greater emphasis on the probability dimension when buying a venture liked venture Z less.

We also find significant relationships between individual level factors and attractiveness ratings for the vignettes. For income we find a significant negative relationship between an individual's income and their attractiveness rating for venture Y. In considering risk propensity, we find significant positive relationships between risk propensity and attractiveness ratings for ventures Y and Z.

## DISCUSSION & CONCLUSIONS

The results from the conjoint experiment demonstrated that the group as a whole considered each of the attributes as expected in forming assessments of their willingness to pay for each venture scenario. The relative preference weights of 45%, 30% and 25% for payoffs, probability and time dimensions compares favourably with the relative preference weights we would expect if average valuations were based on a discounted expected value using a nominal discount rate of 5%. At that discount rate the relative preference weights would be 51%, 31% and 17% respectively. In addition, the part-worth utilities calculated for the group as a whole indicated the extent to which preferences changed across the levels used in the study for each of the three decision attributes. With respect to the payoff dimension, we find part-worth utilities to increase linearly with the potential payoff for the venture consistent with proportional risk averse behaviour (Kahneman and Lovallo, 1993). However, for the probability attribute, we find non-linearity in the part-worth utilities with rapidly decreasing utility as probabilities approach zero and rapidly increasing utility as probabilities of success approaching certainty. We find these results to be consistent with results expected under Prospect Theory (Kahneman and Tversky, 1979). Finally for the time dimension, we find utility to decrease in a roughly exponential fashion. Although the part-worth utility for the 10 year level was greater the part-worth utility for the 5 year level, we suspect this may be more due to methodological problems such as reversals rather than a real effect (Hair, Anderson, Tatham and Black, 1998). In summary, we find the three attributes to contribute significantly to the individuals' valuation. We also find part-worth utilities particularly sensitive at high and low probabilities and for shorter time periods, consistent with the certainty and immediacy effects.

A particular interest in the study was whether knowledge of the preference weights of each individual in the study could be useful in providing a better understanding of an individual's attractiveness assessment for a more realistic venture scenario. If so, further investigations into the preference weights individuals place on relevant venture attribute would be useful in understanding entrepreneurial behaviour when considering venture opportunities. Understanding the differences in preference weights associated with various cognitive biases would also be useful in explorations of entrepreneurial behaviour. Overall, we find some evidence of relationships between elicited preference weights of individuals for valuations and their ratings of hypothetical ventures. We find some evidence those individuals with a greater preference weight for the temporal dimension to prefer ventures with earlier payoffs. For the attractiveness ratings for venture Y (high payoff, low probability of success and a longer time period before payoffs are received) we find evidence that those individuals placing greater emphasis on the payoffs from a venture to rate this particular venture higher. This result may be due to anchoring effects and if so, it may possible to identify individuals prone anchoring biases when evaluating venture opportunities. Similar results were also found for ventures Z (low payoff, high probability of success and a longer time period before payoffs are received). The results in this case were opposite of what we might have suspected, although it may be that given the higher probability of success in this venture, individuals might have focussed on the returns. Overall though the results suggested that preference weightings for venture attributes may be useful in predicting behaviour and consequently we would suggest that further work be encouraged in order to validate the findings.

While we found no evidence of relationships between individual level factors and relative preference weights for payoffs, probabilities and time, we did find evidence of relationships with attractiveness ratings for the three venture vignettes. We find a significant negative relationship between income and an individual's preference for venture Y. Given that venture Y was the high payoff, high risk venture this result is consistent with the opportunity cost argument. Likewise we find significant positive relationships between and individuals risk propensity and their attractiveness ratings for venture Y and Z. The results are consistent with previous research suggesting a relationship between individual risk

propensities and entrepreneurial behaviour. Interestingly, we find no evidence of a relationship between risk propensity and preference weights for payoffs, probabilities or time attributes.

Finally we find evidence of implicit discount rates declining over time which suggests a preference for individuals to prefer ventures with a shorter period before payoffs are received. In order to investigate this temporal discounting further we compared valuations with the expected values of each venture for each of the four time periods in the study. The slope of these lines is the discount factor associated with each time period. By investigating the relationship between these discount factors as a function of time, we find that to a good approximation, the discount factor could be described by a constant multiplied by an exponential term. The discount rate associated with this exponential term was 7%, which is consistent with prevailing interest rates in the market. The constant term was found to be 0.52. This finding suggests that an alternative explanation is that when faced with a valuation problem, respondents simply apply a one time discount as a charge for the risk, consistent with the implicit risk hypothesis (Benzion, Rapoport and Yagil, 1989). This implicit discount rate is independent of time. Alternatively, the observed response may be a methodological problem as suggested by (Frederick, Loewenstein and O'Donoghue, 2002), where individuals adopt a simplifying response pattern of the response/n, where n is often a multiple of 2 or 10. Frederick et al. (2002) also point out that if that is the case then it suggests that individuals do not (or cannot) think carefully about the task. In either case, we suggest that further work be done to investigate this behaviour.

Figure 1. Summary of Importance Weights



Figure 2. Implied Discount Rates versus Time

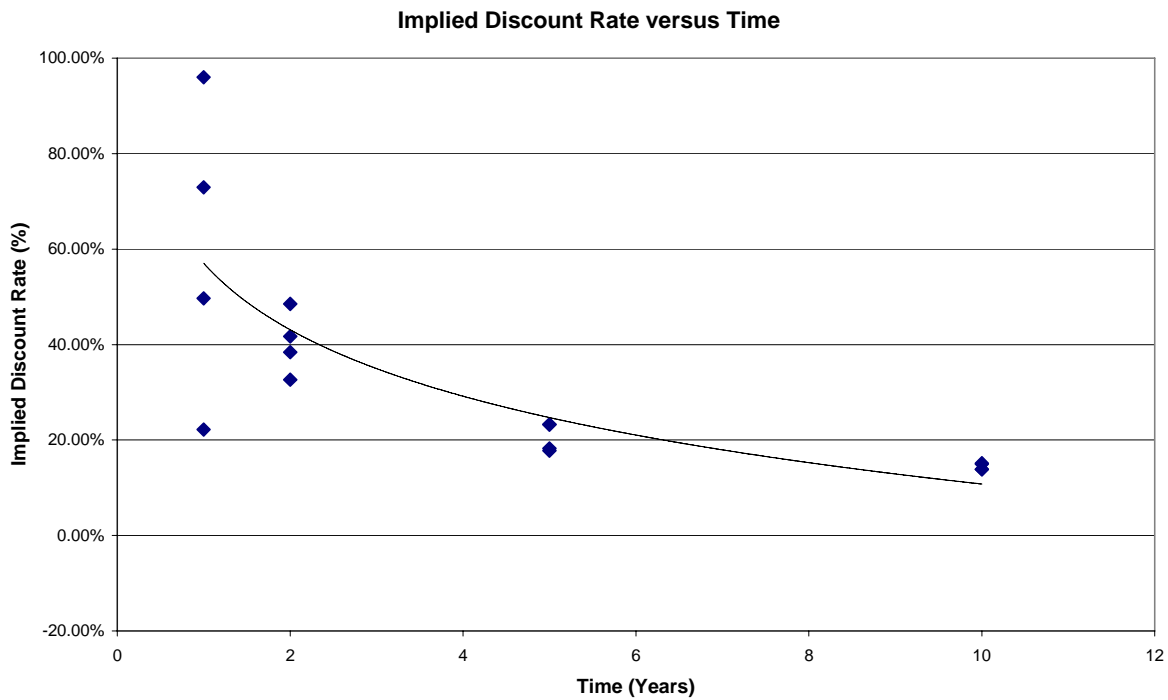


Table 1. Venture Ratings

<b>Venture</b>	<b>Payoff</b>	<b>Risk</b>	<b>Time</b>	<b>Average Rating</b>	<b>S.D.</b>
X	Low	High	Short	3.19	1.23
Y	High	High	Long	3.66	1.28
Z	Low	Low	Long	3.09	1.30

Table 2. Correlations

Correlations

		Venture X	Venture Y	Venture Z	Risk Propensity	Income	WTP_Payoff	WTP_Probability	WTP_Time
Venture X	Pearson Correlation	1	.220	.384**	.161	-.120	.019	-.175	.236
	Sig. (2-tailed)	.	.089	.002	.216	.360	.883	.177	.067
	N	61	61	61	61	60	61	61	61
Venture Y	Pearson Correlation	.220	1	.368**	.323*	-.311*	.253*	-.209	-.085
	Sig. (2-tailed)	.089	.	.004	.011	.016	.049	.106	.516
	N	61	61	61	61	60	61	61	61
Venture Z	Pearson Correlation	.384**	.368**	1	.263*	-.215	.345**	-.285*	-.114
	Sig. (2-tailed)	.002	.004	.	.041	.099	.007	.026	.380
	N	61	61	61	61	60	61	61	61
Risk Propensity	Pearson Correlation	.161	.323*	.263*	1	-.131	-.007	-.082	.137
	Sig. (2-tailed)	.216	.011	.041	.	.320	.955	.529	.293
	N	61	61	61	61	60	61	61	61
Income	Pearson Correlation	-.120	-.311*	-.215	-.131	1	-.205	.223	-.009
	Sig. (2-tailed)	.360	.016	.099	.320	.	.116	.087	.948
	N	60	60	60	60	60	60	60	60
WTP_Payoff	Pearson Correlation	.019	.253*	.345**	-.007	-.205	1	-.795**	-.382**
	Sig. (2-tailed)	.883	.049	.007	.955	.116	.	.000	.002
	N	61	61	61	61	60	61	61	61
WTP_Probability	Pearson Correlation	-.175	-.209	-.285*	-.082	.223	-.795**	1	-.257*
	Sig. (2-tailed)	.177	.106	.026	.529	.087	.000	.	.046
	N	61	61	61	61	60	61	61	61
WTP_Time	Pearson Correlation	.236	-.085	-.114	.137	-.009	-.382**	-.257*	1
	Sig. (2-tailed)	.067	.516	.380	.293	.948	.002	.046	.
	N	61	61	61	61	60	61	61	61

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

## APPENDIX A

### **BUSINESS OPPORTUNITY X**

The business opportunity in this case is the chance to obtain the exclusive distribution rights for the Greater Brisbane area (or a similarly sized city in your home country) from the manufacturer of a fun toy designed to appeal to schoolchildren up to lower teenage years (cf. Tamaguchi a few year's ago). The product has rapidly reached very high sales in the target segment in some similar markets, while in other markets it has not taken off at all and sales have been dismal. Either way, the user typically tires of the product relatively quickly. Hence, no income from service, supplementary or replacement purchases should be expected.

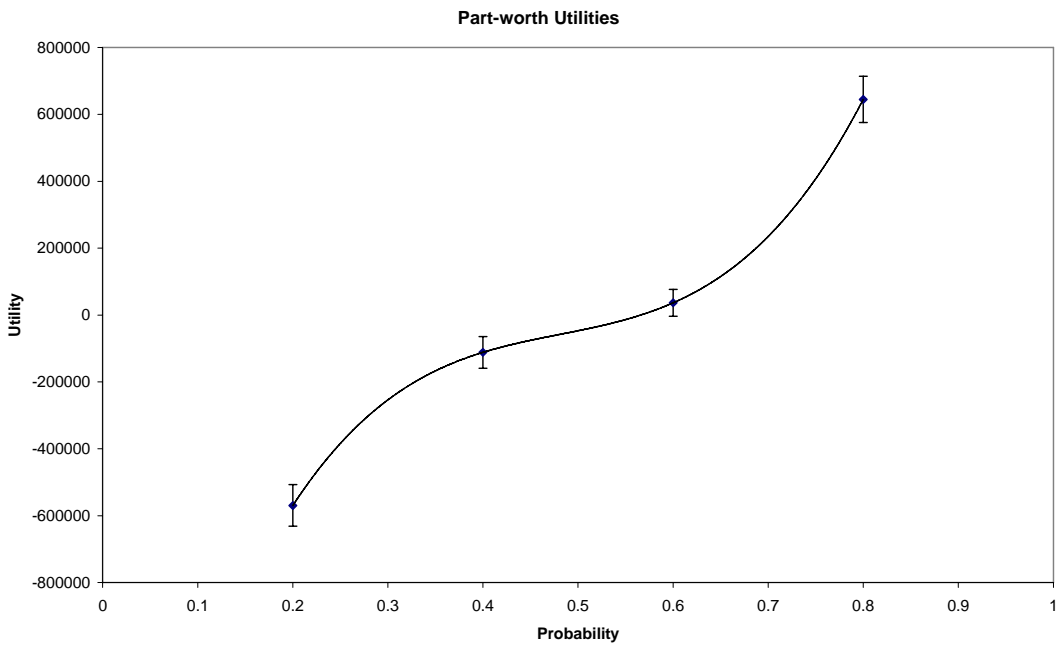
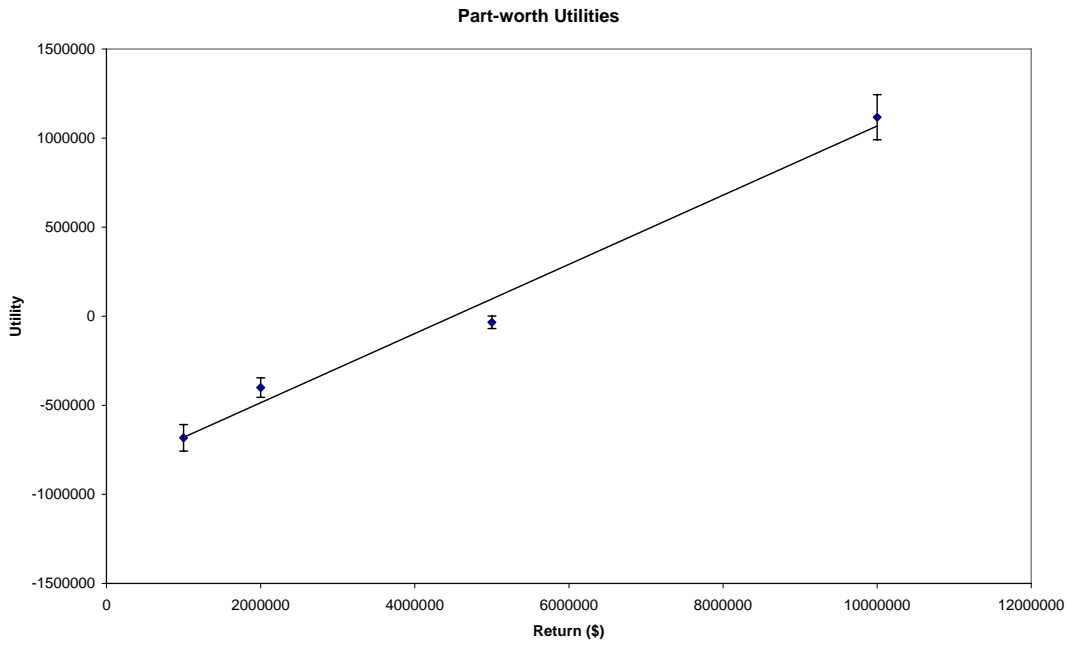
### **BUSINESS OPPORTUNITY Y**

The business opportunity in this case is the chance to introduce an innovation that provides substantial energy cost savings in commercial buildings. While the innovation has strong intellectual property protection, the cost saving ability of the innovation has not yet been proven in full scale practice, and is dependent on correct execution of rather complex procedures. Hence, the success in the market is ultimately going to depend on convincing early adopters of the benefits and on the cost savings they actually experience. The logic of the innovation is such that it only makes sense for commercial building owners to invest in it when the building is constructed or is undergoing major renovations. In addition, the building owners decision to buy this innovation has to be made early in the process, which can be several years before actual delivery and payment. This opportunity is not restricted to any particular geographical market.

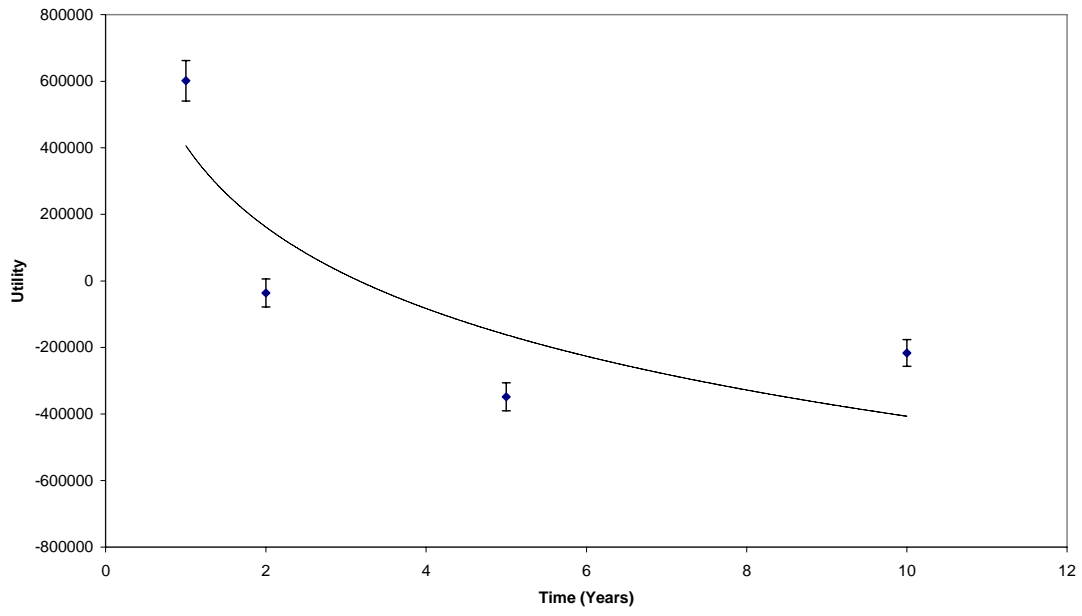
### **BUSINESS OPPORTUNITY Z**

The business opportunity in this case is the chance to introduce into Australia (or a similarly populated region in your part of the world) an innovation that provides substantial cost savings in the process of operating special schools for disabled children. The innovation has strong intellectual property protection in Australia (or the relevant region) and has been proven to offer substantial cost savings. However, the logic of the innovation is such that it only makes sense for a school to invest in it when the school is newly built or has undergone substantial renovations. In addition, the school's decision to buy this innovation has to be made early in the process, which is typically some years before actual delivery and payment. As the innovation benefits from particularities of the laws and regulations in Australia (or the relevant region) the concept is unlikely to do well in export markets.

# APPENDIX B



Part-worth Utilities



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