



Impact of Cognitive Biases on Decision Making by Financial Planners: Sunk Cost, Framing and Problem Space

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Abstract

The **aim** of this paper is to test the existence of the framing effect and sunk cost effect whilst examining the influence of cognitive factors. The **approach** to this research involved combining two frameworks, Prospect Theory and Image Theory, to analyse the outcomes of financial decision making from a survey of financial planners. The **findings** confirm the existence of the framing effect and a sunk cost effect. In particular the lowering of the amount of sunk cost produced a higher mean funding outcome than that attained in the positive frame. With regards to cognitive factors a significant correlation between perception of responsibility and the amount of funding granted was identified. This is consistent with the existence of escalation commitment behaviour, which is considered to be a manifestation of feelings of responsibility. The perception of the problem space produced an unexpected set of results. In particular both low image compatibility and high image compatibility were significant predictors of the level of funding granted.

Keywords: Framing effect, Sunk cost effect, Decision-making, Prospect Theory, Image Theory

1. Introduction

An emerging issue for investment analysis and financial decision making has been the trend for individuals to seek financial advice concerning investment for future financial security in particular with regards to superannuation. The growth in this sector has led to the recognition of Financial Planners as experts in investment analysis arising from the process of professional training they are required to undertake (Oskamp, 1965; Bradley, 1981; Sundali & Atkins, 1994).

Portfolio theory which is commonly used in investment analysis starts with the proposition that all investors are “risk-averse” and will seek to maximize their return for the level of risk they are prepared to accept (Markowitz, 1959). The underlying principle is that decision makers will act in a rational manner (Rich & Oh, 2000). However, empirical research has found that the axioms of rationality (Savage 1954; and Sugden 1991), are violated across a range of financial decision making situations (Hernstein 1990; and Keen 2001). One focus of prior research has been concerned with exploring a person’s level of risk tolerance and the reliance on mental accounts (Thaler 1985, 1990; and Kahneman & Tversky, 1979). That individuals formulate as a cognitive process which they then rely upon to evaluate events or choices. Kahneman and Tversky (1979) found that the cognitive process can be influenced by the way in which the prospects of the alternative courses of action are framed, that is as positive (gains), or negative (losses). Financial planners’ tolerance for risk may influence the nature of the investment choices they make. Their tolerance for risk may be the result of a misdirected perception of risk (Fischhoff, Slovic & Lichtenstein, 1981), arising from a reliance on biased heuristics.

The purpose of this paper is to empirically examine the decision processes of practicing financial planners using a situation which is representative of financial investment decisions. The instrument used is grounded in the behavioural literature and should therefore be expected to provide reliable measures of the respondents’ decision processes. The paper contributes to the behavioural finance literature concerned with the effects of heuristic biases on financial decisions. The paper analyses more closely the relationship between Prospect Theory and Image Theory in order to provide an integrated framework for examining financial decision making.

2. Literature Review

The literature on decision-making assumes that individual decision-makers use some form of judgemental heuristics as a general strategy to simplify complex decision tasks. Research has identified a number of anomalies that highlight the subjective nature of decision making in real world settings. Factors, such as the sunk cost effect (Arkes & Blumer, 1985), and escalation of commitment (Staw 1976, 1981) have been shown to adversely influence decision making. Behavioural models such as Prospect theory (Kahneman & Tversky, 1979) and Image theory (Beach, 1990) are particularly relevant to examining the cognitive biases that individuals encounter when forming judgmental heuristics for making decisions.

Prospect theory (Kahneman & Tversky, 1979) is based upon the notion that there are two phases to decision making: an initial editing phase and a subsequent evaluation phase. The editing phase allows for the information to be organised

and reformulated, thereby simplifying the evaluation phase. The evaluation phase is based upon the assumption that values are attached to changes rather than final states and that decision weights do not coincide with stated probabilities. The theory predicts that when outcomes are framed in a positive manner (gains), there is a n observable propensity for decision makers to be risk-averse, and conversely when the frame is negative (losses), decision makers are more likely to be risk-seeking (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981, 1986). Decision framing has also been described Tversky & Kahneman, 1981, 1986), as involving mental accounting in which individuals form psychological accounts of the advantages and disadvantages of an event or choice. This infers that individuals create mental images that influence their decision making process.

Image theory (Beach, 1990) provides a model for examining images created by decision makers. The theory predicts that the decision made by an individual is a function of the perception of three images (Mitchell, Rediker & Beach, 1986; Dunegan, Duchon & Ashmos, 1995). Value image is related to the value, moral or ethical nature of the choice and is the basis for establishing goals. Trajectory image relates to the agenda that underlies the goals. Strategic image implies tactics and forecasts which relate to the goals. Image compatibility is considered to act as a moderating variable, influencing the degree to which information may be used by an individual when making a decision. The conceptual representation of the images constructed by an individual is identified as by Payne (1980), as the problem space and has been shown to be related to the framing effect in prospect theory (Dunegan, Duchon & Ashmos, 1995).

2.1 Framing Effects

Research has shown that individuals will respond differently to the same decision problem when the problem is presented in a different format. This phenomenon is referred to as a framing effect (Kahneman & Tversky, 1979). Framing effects can have the potential to impede the accuracy of financial decisions. Empirical research has demonstrated that an individual can be influenced by the way in which information is presented (Kahneman & Tversky, 1979). A frame according to Beach (1990, 23) is “*a mental construct consisting of elements, and the relationship between them, that are associated with a situation of interest to a decision maker.*” The frame may therefore be thought of in terms of a representation of a situation through which a decision maker gains understanding or makes sense of the alternative courses of action available.

One explanation for this phenomenon is that when a decision maker focuses on the negative, there is a greater urgency to engage in preventative behaviour rather than explore other options. Research (March & Shapira, 1992) suggests that individuals are likely to become more survival oriented when focusing on losses which threaten to deplete their resources and more aspiration oriented when focused on positive goals. Since “losses loom larger than gains” according to Kahneman and Tversky (1979), examining the negative frame should shed more light on the propensity to take risks by financial planners. The assumption being that decision makers are more likely to be influenced by negative framing leads to the following null hypothesis to be tested.

Ho₁: The negative framing of the task will not result in a higher amount of funding allocation.

2.2 Sunk Costs

Decision models in finance follow normative economic decision theory and implicitly, rather than explicitly, are dismissive of sunk costs. This is evident in finance theory, which holds that only future cash inflows and outflows should influence decisions. Sunk costs are by definition “*past and irreversible outflows. ... they cannot be affected by the decision to accept or reject the project, and so they should be ignored.*” (Brealey & Myers, 1991, 95) Portfolio theory and the net present value method are commonly used to assess alternative investment opportunities. In an investment decision, past costs, or sunk costs, are deemed to be irrelevant. Despite this, there is evidence which demonstrates that sunk costs, are not always ignored as prescribed; this is described as the “sunk cost effect” or the “sunk cost phenomenon” (Tversky & Kahneman, 1981; Akers & Bulmer, 1985).

Prior research has demonstrated that individuals can be influenced by past costs when making economic decisions (Arkes & Blumer, 1985). Tversky and Kahneman (1981), suggested that individuals form accounts (psychological accounts), regarding the advantages and disadvantages of an event or option in order to appraise costs and benefits of outcomes. This suggests that past experiences, such as sunk costs, can influence they way in, which an individual makes a decision and this leads to the following null hypothesis for testing.

Ho₂: The amount of sunk cost will not result in a different amount of funding allocation.

2.3 Escalation of Commitment

Linked to the sunk cost effect is the bias to commit resources to justify previous actions, whether or not the rationale for those initial commitments is still valid. Staw (1976, 1981) found that individuals tend to escalate their commitment to previous decisions, even if the behaviour does not appear rational. Research has shown that individuals who are responsible for making an initial decision are more likely to make further decisions in a biased way to justify their earlier decision (Staw & Ross, 1978; Teger, 1980; Bazerman, Beekun & Schoorman, 1982; Bazerman, Guiliano &

Appleman, 1984; Brockner & Rubin, 1985; Schoorman, 1988). A consequence of this bias is that further funds may be committed to justify previous actions, whether or not the rationale for those initial actions are still valid (Brockner & Rubin, 1985; Schoorman, 1988). The possibility that escalation to commitment may occur in investment appraisal leads to the following null hypothesis.

H₀₃: The perceived level of responsibility for the initial decision will not be positively correlated to the amount of funding allocated.

2.4 Problem Space

The role of cognition is well documented as a salient factor in decision making (Newell & Simon, 1972; Lord & Maher, 1990). Specific research has explored the processes that result in perceptions about conditions regarding the decision (Bowen, 1987; Lord, 1985). Payne (1980) referred to these perceptions collectively as the problem space, which is an individual's cognitive representation of a task environment. Framing has been shown to have a direct influence on the perception of the problem space and therefore the decision outcome (Dunegan, 1993). The problem space relates to the conceptual representation of the task constructed by an individual (Payne, 1980). Examining the problem space may provide greater insight into the cognitive representation or perception that an individual has of the task. Therefore, if the framing effect can influence the problem space perception it may provide a better understanding of the anomalies related to decision making process. The following null hypothesis was developed to test whether differences in perception of the problem space may explain the decision outcome of individuals.

H₀₄: The framing of a task will not influence the perceptions of the problem space.

The way in which a decision maker cognitively processes information can be measured by the cognitive perception of the problem space (Langer, 1989; Isen, 1989; Fazio, 1990; Maheswaran & Chaiken, 1991; Louis & Sutton, 1991). The proposition is that when controlled modes of cognitive processing are used, information is subjected to a more comprehensive, deliberate and thorough analysis. Conversely, when automatic modes are used, the processing of information is limited. In addition, there is reduced attention to detail and fewer incoming cues to contribute to a cognitive representation of the task (Dunegan, 1993). Controlled processing was expected to produce a significant relationship between problem space measures and decision outcomes (funding), because problem space should be more easily recalled and used in the controlled mode. In the automatic mode, the problem space is not easily recalled for conscious use and the relationship between problem space and decision outcomes should be weak or non-significant. The following null hypothesis was developed to test whether different perceptions of the problem space caused by the framing effect are likely to produce different decision outcomes.

H₀₅: The eight problem space variables will not be positively correlated to the variance in funding allocation.

2.5 Image Compatibility

Image Theory posits that decisions made by individuals are a function of the perceptions of three images (Beach, 1990; Beach & Mitchell, 1990; Mitchell & Beach, 1990). The three images are value images, pertaining to a consolidation of morals, principles and predispositions; trajectory images, pertaining to an individual's future objectives or targets; and strategic images, consisting of current plans and tactics (Mitchell, Rediker & Beach, 1986; Dunegan, Duchon & Ashmos, 1995). These images are relevant to decisions concerning adoption and progress choices. Adoption decisions are concerned with new projects, plans, or activities. Progress decisions are related to deliberations concerning projects, plans or activities already commenced. These are the types of activities that investment appraisal is concerned with.

In both adoption and progress decisions, image theory implies that image compatibility acts as a catalyst for differentiated actions (Dunegan, Duchon & Ashmos, 1995, 32). When information is perceived as positive, the trajectory and strategic images are compatible and no change in course of action is deemed to be warranted by a decision maker. Conversely, when information is perceived as negative, images appear incompatible and the decision maker is more likely to take action intended to rectify the situation (Beach et al., 1992). Research has shown that image compatibility can act as a moderating variable, influencing the degree to which information is used by a decision maker in choosing a course of action (Dunegan, Duchon & Ashmos, 1995). To test whether image compatibility would act as moderating variable influencing the degree to which information was used in choosing a course of action the following null hypothesis was designed.

H₀₆: The perception of the problem space will not be correlated with the perceived image compatibility.

Research has further identified that when image compatibility was high, that is, progress toward the goal on the trajectory image was perceived to be acceptable, then the relationship between the problem space and funding levels are low (Dunegan, Duchon & Ashmos, 1995). Conversely, when image compatibility was low, the perception of the problem space and funding decisions were significantly higher. Therefore, the following two null hypotheses were developed to test the expectation that the decision outcome and the perception of the problem space would be opposite to the image compatibility.

H₀₇: The perceived image compatibility will not differ between decision outcomes.

H₀₈: The perceptions of the problem space and decision outcomes will not be high when perceived image compatibility is low.

3. Data Collection

3.1 Target Population and Sample Selection

The target population was selected from the category “Financial Planners” in the Australian Yellow Pages Telephone CD Rom edition. Several stages were involved in developing the database for the sample. First, the search was restricted to Queensland Financial Planners: a total population of 863. This was done to keep the survey at a manageable level and because the issues presented in the survey instruments are relevant to financial planners, no matter which state in Australia they were situated. A sample of 265 was randomly selected from the remaining population. The sample size was determined in accordance with Leedy (1997, 211). and random sampling method followed the steps prescribed by Krathwohl (1998).

3.2 Survey Instruments

Three versions of the investment tasks were developed which differed slightly with regard to specific details. The first two contained the same amount of sunk cost, however, one had a positive frame and the other a negative frame. The third version had a negative frame, however, the amount of the sunk cost was reduced. In addition to the framing and sunk cost manipulations there were questions, which addressed cognitive perceptions of problem space and image compatibility in all three versions.

For the purpose of this research, the decision maker was referred to as the “Fund Manager”, which was used to compliment the nature of financial planning and investment advising consistent with the industry role of the subjects. In introducing the instrument’s task, the subjects were asked to adopt the role of a Fund Manager who, having instigated an investment project sometime in the past, is now confronted with a request for additional funds by the team responsible for the investment project. The team is seeking an additional \$100 000AUD, as the investment project is behind schedule and over budget. The actual sunk cost of the initial investment was identified as \$400 000AUD. This was considered a reasonable amount to influence the subjects as the \$100 000AUD requested now represented one quarter of this sunk cost. The Fund Manager has \$500 000AUD in unallocated funds; however these funds may be required for other projects and there is some time left before the end of the current financial year. The details of the differences between the sunk cost and framing for the three scenarios are highlighted in Table 1 below.

Insert Table 1 Here

In addition, the subjects were instructed that they believe there is a “fair chance” the project would not succeed. The final statement was the pertinent framing effect. The final statement given to the subjects specifically established the pertinent framing effect. The positive frame stated that, “*Of the projects undertaken by this team, 30 of the last 50 have been successful*”, while the negative frame differed with respect to the last part of the statement “*Of the projects undertaken by this team, 20 of the last 50 have been unsuccessful*”. Note that in both the negative and positive scenarios, the ratios lead to the same result.

Subjects were advised that the actual time remaining till the end of the financial year was 6 months; this imposed a time frame that was considered a reasonable challenge to the subject’s perception of risk. The subjects could view the 6 months as half the year being past or as half the year remaining (Dunegan, 1993). The variables for this scenario are summarised in Table 2 below:

Insert Table 2 Here

3.3 Sample Size and Response Rate

Where the actual population is known, the statistical method for determining an appropriate sample size can be employed. In this case the appropriate sample size was determined to be 265 ($N=850$ $s=265$). (Leedy, 1997, 211). Following the initial mail out of surveys, 30 were returned with the notification that the address was no longer correct. These were replaced by randomly selecting 30 replacements. Eighty-six useable responses were received, the response rate was 32.5%. This response rate was considered satisfactory for the size of the population and the purpose of the survey.

3.4 Non-Response Bias

The likelihood of non-response bias was assessed using late responses as a proxy for non-responses. A comparison of the variables provided little difference between early and late respondents. The chi-square for early/late responses was χ^2 0.641 with $df=1$. Since the subjects were selected from a population that was known to be largely homogenous, major differences between respondents was unlikely.

4. Data Analysis

4.1 Statistical Methods

Eight hypotheses were generated with regard to the reinvestment decision scenarios. These called for the use of a t-test (for null hypothesis 1), an ANOVA (for null hypotheses 1, 2 and 3), a MANOVA (for null hypothesis 4), and a multiple regression analysis (for null hypotheses 6, 7, and 8). A principal component factor analysis was conducted as an additional test on the data regarding the perceptions of problem space and image compatibility. The results and their interpretation are discussed below. The results of the analysis of the data are presented in order of the null hypotheses established earlier in this paper.

4.2 Analysis of Reliability

Table 3 presents the mean and standard deviations for the funding amounts and the total subjects in the sample for each of the task versions that were administered.

Insert Table 3 Here

There were differences between the means of the negative framed and positive framed versions of the task. Having established that the funding levels were significantly different between each version of the task further analysis was warranted to examine the significance of the framing effect on the amount of funding.

4.3 Testing the Framing Effect on Funding

Testing the framing effect on funding involved using the funding (or resource allocation from \$0 to \$100 000), as the dependent variable and framing (dummy coded 1 or 2), as the independent variable.

A comparison of the means uses a two-sample independent *t*-test (two-tailed). Revealed a significant difference between funding levels ($t = 2.338$, $p < .023$). This result indicates that the frame manipulation was successful. The null hypothesis (H_{01}) is therefore rejected.

To test the difference between the experimental conditions (decision choices versus positive and negative framing), an analysis of variance (ANOVA) for repeated measures was performed by comparing task versions 1 against 2 ($F = 4.755$, $p = 0.011$, $df = 2$). Since each of the three groups was treated identically, except for framing; differences were expected to be evident among them. This result confirms that the total variance in funding was significantly related to the differences in framing.

4.4 Testing the Sunk Cost Effect on Funding

To test the Sunk Cost Effect on Funding a one way analysis of variance (ANOVA) was conducted with the funding (decision outcome), as the dependent variable and framing (dummy coded). As the independent ($F = 8.596$, $p < 0.005$, $df = 1$). The scenarios relevant to the testing of this null hypothesis are task version 1 (negative framing with high sunk cost), and task version 3 (negative framing with low sunk cost). The null hypothesis (H_{02}) is therefore rejected. This result shows that there was a significant difference between the mean of funding for the high sunk cost frame and the low sunk cost frame scenarios. The direction of the difference was the low level of funding (\$39 354), in the high sunk cost version and the higher level of funding (\$60 227), in the low sunk cost version. This suggests that the difference in the amount of sunk cost may have an impact on the sunk cost effect.

The sunk cost effect was significant and the mean for funding allocation was greater in the task version with the lower sunk cost. These findings are consistent with the assumptions of prospect theory.

4.5 Testing the Perception of Responsibility on Funding

To test the perception of responsibility on funding allocation a one-way analysis of variance (ANOVA) was conducted with the problem space item for responsibility as the dependent variable and the amount of funding as the dependent ($F = 4.023$, $p = 0.005$, $df = 4$). Testing involved funding (from \$0 to \$100,000), as the dependent variable and perceived level of responsibility (scaled from 1 to 5), as the independent variable. This result shows that there were statistically significant differences between the amount of funding and the perception of responsibility. The null hypothesis (H_{03}) is therefore rejected. A further ANOVA was conducted using the intention to fund against the perception of responsibility ($F = 0.809$, $p = 0.523$, $df = 4$). This result shows that there were no statistically significant differences between the intention to fund and the perception of responsibility.

4.6 Testing the Framing Effect on Perceptions of Problem Space

To test the framing effect on perceptions of problem space a multivariate analysis of variance (MANOVA) was conducted with eight (8), problem space items as dependent variables and framing (dummy coded), as the independent ($F = 2.235$, $p < .038$). The test was restricted to task version 1 (negative frame and high sunk cost), and scenario 2 (positive frame and high sunk cost). To compare task version 2 against task version 3 would be to introduce a

confounding variable, That is task version 3 whilst consisting of a negative frame has a low sunk cost, which could invalidate the findings and it was therefore not used in this test.

The result indicates that the perception of problem space differs between the task version 1 (negative frame). and 2 (positive frame). Therefore, there is a significant difference (at $\alpha = .05$). due to framing. Interestingly, the mean of the funding amount was lower in the negative frame (\$39 354), than in the positive frame (\$53 484). This confirms the influence of a framing effect on the perceptions of problem space. The null hypothesis (H_{04}) is therefore rejected.

To test the relationship between the variance in funding allocation and the problem space items a series of multiple regression analysis was performed, one for each framing condition, with funding as the criterion variable and all eight problem space variables simultaneously entered as predictors. The results of these tests are reported in Tables 4, 5, and 6. The reason for entering all eight problem space variables in the model simultaneously was to control for any shared variance among the predictors.

Insert Table 4 Here

The results for the negative framed task resulted in only 43.9% of the variance in funding being explained by the eight independent variables the result is therefore not significant. The perceptions of problem space are not significantly related to the funding decision in this negative framed task. This is a surprising and most unexpected result and inconsistent with the findings of previous research, which indicated that negative framing could be expected to result in a higher level of controlled decision processing.

Insert Table 5 Here

Insert Table 6 Here

To determine whether significant differences existed between the predictive powers of the regression models, a comparison was conducted of adjusted R^2 values using Fisher's transformation for multivariate R (refer Hayes, 1988, 644-645). The capacity of the positive frame model was found to be significantly greater.

Negative Frame = $C_R = 0.388$; critical value = 1.96, two-tailed test, not significant.

Positive Frame = $C_R = 2.08$; critical value = 1.96, two-tailed test, **significant**.

Negative Low Sunk Cost Frame = $C_R = 1.270$; critical value = 1.96, two-tailed test, not significant.

These results are not consistent with previously reported findings (Dunegan Duchon and Ashmos, 1995). in which the negative framing resulted in a stronger relationship to the amount of funding. The results indicate that the positive framed task exhibited stronger cognitive relationships to the problem space perceptions than the negative framed tasks.

A number of possible explanations and observations are considered here. First, that the negative framing did not elicit the expected cognitive behaviour may be due to the unexpected risk-avoidance exhibited in the negative framed outcomes. The negative frame should cause decision makers to exhibit risk-seeking behaviour, which would be manifest in the means of the funding being larger (not smaller), than the positive framed scenario outcomes. Second, the additional information and modifications to the wording of the task may have been responsible. The respondents may have felt more certainty about the financial situation and this could also explain the higher funding in the positive framed scenario. The significantly different (higher amount of funding), from the positive frame suggests that the information may well have influenced characteristics of the cognitive modes exhibited by the subjects in their decision making.

4.7 Analysis of Internal Structure Image Compatibility

The internal structure of the four image compatibility items was explored by a principal-component analysis using an orthogonal Varimax rotation. By specifying a minimum eigenvalue of 1.0, a single factor for image compatibility was determined. The factor accounted for 81.7% of the variance in the four items. The items were collapsed into a single measure of image compatibility. The procedure of collapsing these data involved adding the scores of the four items to produce a single measure (Dunegan, Duchon & Ashmos, 1995). The component matrix is reported in Table 7.

Insert Table 7 Here

Extraction method: Principal Component Analysis.

Only one component was extracted. The solution cannot be rotated.

Descriptive statistics for the survey items are shown in Table 8. These data indicate that funding levels were significantly correlated with image compatibility and all but three of the problem space items.

Insert Table 8 Here

4.8 Testing the Correlation between Perceptions of Problem Space and Image Compatibility

To test the correlation between perceptions of problem space and image compatibility two regression analyses were performed to control for shared variance among problem space items. First, funding (decision outcome) was regressed

on the eight problem space items. Fifty percent of the variance in funding was predicted by the group of eight problem space items ($F=9.729$, $p<.000$). The null hypothesis was rejected. Second, image compatibility (collapsed measure) was regressed on the eight problem space items. Eighty-nine percent of the variance in image compatibility was predicted by the group of eight problem space items ($F=80.244$, $p<.000$). The null hypothesis was rejected. These results indicate that there was a significant relationship between perceptions of the problem space and perceived image compatibility. This finding is consistent with Dunegan, Duchon and Ashmos (1995).

To test the perceived image compatibility as a moderating variable on the decision outcome three steps were involved. First, to test whether image compatibility added anything to the predictive powers of the model the same regression analysis was performed, except that in this model image compatibility (the factor condition) was added to the independent variables (that is, $\text{Funding} = \text{Intentions} + \text{Risk} + \text{Disappointment} + \text{Importance} + \text{Responsibility} + \text{Minimise loss} + \text{Sunk costs} + \text{Control} + \text{Image}$). The addition of image compatibility increased the model's ability to predict funding allocation increased from 55% to 59% ($R^2 = 0.550$, $F = 10.313$ $p<0.000$).

Second, the regression model was then expanded to include the eight first-level interactions between image compatibility and the problem space items. The interaction variables were created by multiplying each problem space item by the image compatibility factor, as reported by Dunegan, Duchon and Ashmos (1995, 35). The expanded model is represented by the following [$\text{Funding} = \text{Intentions} + \text{Risk} + \text{Disappointment} + \text{Importance} + \text{Responsibility} + \text{Minimise loss} + \text{Sunk costs} + \text{Control} + \text{Image} + (\text{Intentions} * \text{Image}) + (\text{Risk} * \text{Image}) + (\text{Disappointment} * \text{Image}) + (\text{Importance} * \text{Image}) + (\text{Responsibility} * \text{Image}) + (\text{Minimise loss} * \text{Image}) + (\text{Sunk costs} * \text{Image}) + (\text{Control} * \text{Image})$].

With the addition of the interaction items the model's ability to predict funding increased from 55% to 59% ($R^2 = 0.594$, $F = 5.842$, $p<0.000$). This increase was significant at the $p<.05$ level. Therefore, these data indicate that image compatibility does moderate the relationship between decision outcomes and problem space perceptions.

To determine the nature of the interaction between image compatibility and the group of eight problem space items the compatibility measure was split at the mean into two groups, a low compatibility group and a high compatibility group (Dunegan, Duchon & Ashmos, 1995, 36). The ability of problem space items to predict the level of funding in the High and Low image ranges was similar. The result of the regression model for Low image compatibility was ($F = 3.925$, $p < .002$, $R^2 = .452$). The result of the regression model for High image compatibility was ($F = 2.714$, $p < .022$, $R^2 = .420$). However, when the image compatibility was low, the predictability was statistically significant.

4.9 Additional Tests of the Data

The internal structure of the eight problem spaces was explored by a principal-component analysis with an orthogonal Varimax rotation. By specifying a minimum eigenvalue of 1.0, three factors were determined to be contributing significantly to the patterning of variables. These three factors accounted for 81.7% of the variance (cut off at .30) between the factors identified by the principal- component analysis.

Insert Table 9 Here

Extraction method: Principal Component Analysis.

Rotation method: Varimax with Kaiser Normalisation.

Rotation converged in 5 iterations.

* The response scale for this item was reversed; therefore negative result indicates a positive correlation

The prominent item in Component 1 was sunk cost which combined with the other items in the factor suggested the title "sunk cost" as an appropriate descriptor. The details of the component matrix for all three factors are presented in Table 9. As expected, the sunk cost was a major issue in the decision to commit to further investment in the project. This is positively correlated with the amount of funds allocated and provides additional support for the existence of the sunk cost effect.

The combination of items in Component 2 was suggestive of the concept of the "autocentric" style as this consisted of items relating to personal feelings of importance, responsibility, and control. Accordingly, the term autocentric appeared to be an appropriate descriptor for this factor. Component 2 was consistent with cognitive and personality variables which suggest an autocentric side to the behaviour. That is the person was more likely to be responding to issues concerning the perceived level of personal responsibility and locus of control over the events. That all three items were positively correlated is consistent with the notion that these are underlying drivers which when combined would motivate a person to commit further funds to an investment.

The items in Component 3 were suggestive of the concept of "risk" with the prominent items being risk, and disappointment. Accordingly, the term risk appeared to be an appropriate descriptor for this factor. This component was

intuitively consistent with the notion of risk utility, with both the level of disappointment in the progress of the project and the level of perceived risk.

Separate descriptive statistics were computed for the data in each of the three framing conditions. A brief examination of the results indicates that two problem space elements were significantly correlated with funding when the frame was positive. In addition, one problem space element was significantly correlated with funding when the problem space was negative and the sunk cost lower.

5. Discussion

First, the granting of additional funds was significantly higher for a positive framed task than a negative framed task that had the same level of sunk cost. This finding was contradictory to the predicted risk propensity of prospect theory. However, the findings were consistent with some other studies. When the amount of sunk cost was reduced, the provision of additional funds increased. Task version "3" consisted of a negative frame with low sunk cost. However, the interesting aspect of this result was that the positive frame produced a higher mean funding outcome than the negative frame which implies that the positive framing elicited risk-seeking behaviour contrary to the prediction of prospect theory.

Second, the perception of responsibility for the initial decision was found to exert an influence over the amount of funding provided. Staw and Ross (1978) predicted that responsibility for the initial decision would cause subjects to escalate their commitment as a form of justification that the initial decision was correct. The results support this theory since the level of responsibility was positively correlated with the level of funding provided.

Third, the results of the test concerning the problem space were not consistent with the previously reported findings. The results indicated that the positive framed scenarios exhibited stronger cognitive relationship to the problem space perceptions than the negative framed scenarios. This is incongruent with the findings of Dunegan Duchon & Ashmos (1995). They found that the negative framing resulted in a stronger relationship to the amount of funding.

A number of possible explanations and observations are considered here. First, that the negative framing did not elicit the expected cognitive behaviour may be due to the unexpected risk-avoidance exhibited in the negative framed outcomes. The negative frame should cause decision makers to exhibit risk-seeking behaviour, which would be manifest in the means of the funding being larger (not smaller) than the positive framed scenario outcomes. Second, the additional information and modifications to the wording of the task may have been responsible. The respondents may have felt more certainty about the financial situation and this could also explain the higher funding in the positive framed scenario. The significantly different (higher amount of funding) from the positive frame suggests that the information may well have influenced characteristics of the cognitive modes exhibited by the subjects in their decision making.

Fourth, testing of image compatibility produced mixed results. Consistent with the theory, low image compatibility was a significant predictor of the level of funding. The surprise finding was that high image compatibility was also a significant predictor of the level of funding. However, the statistical significance was smaller compared to that of the low image compatibility and the percentage increase in the R^2 was also smaller by comparison.

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Table 1. Summary of Task Details Pertaining to R&D Reinvestment (N=86).

<i>Version</i>	<i>Wording</i>	<i>Framing</i>
1 (n=31).	High Sunk Cost (\$400 000).	Negative
2 (n=33).	High Sunk Cost (\$400 000).	Positive
3 (n=22).	Low Sunk Cost (\$100 000).	Negative

Table 2. Summary of Variables for Reinvestment Decision

<i>Variable Category</i>	<i>Number</i>	<i>Details</i>
Treatment Effect: (Treatment Variables).	One	Framing (positive vs negative). Sunk Cost (high vs low).
Demographic Variables: (Independent Variables). [Predictors]	Two	Problem space inventory Image compatibility
Dependent Variables: (Criterion Variables).	Two	Choice to provide NIL funds Choice to provide a level of funds

Table 3. Descriptive Details of Investment Task

<i>Task version</i>	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>
1 Negative~S/C High	31	39 354	22 536
2 Positive~S/C High	33	53 484	25 601
3 Negative~S/C Low	22	60 227	29 296
Total	86	50 116	26 667

Table 4. Multiple Regression – Funding Regressed on All Eight Problem-Space Measures (Negative~1).

	Measure	<i>F</i>	<i>dfs</i>	<i>R2</i>	<i>Adjusted R2</i>	<i>Standardised beta coefficients</i>	<i>t</i>	Sig.
1	Funding	2.149	8, 22	.439	.235			
2	Intentions					0.504	2.614	0.016
3	Risk					-0.192	-1.101	0.283
4	Disappointment					-0.215	-1.192	0.246
5	Importance					0.020	0.096	0.924
6	Responsibility					0.162	0.790	0.438
7	Minimise loss					0.279	1.283	0.213
8	Sunk costs					-0.028	-0.112	0.912
9	Control					-0.059	-0.305	0.764

Table 5. Multiple Regression – Funding Regressed on All Eight Problem-Space Measures (Positive~ 2).

	<i>Measure</i>	<i>F</i>	<i>dfs</i>	<i>R2</i>	<i>Adjusted R2</i>	<i>Standardised beta coefficients</i>	<i>t</i>	Sig.
1	Funding	5.122*	8, 24	.631	.507			
2	Intentions					0.248	1.822	0.081
3	Risk					-0.559	-3.621	0.001
4	Disappointment					0.002	0.013	0.990
5	Importance					0.254	1.344	0.191
6	Responsibility					0.289	1.896	0.070
7	Minimise loss					0.193	1.189	0.246
8	Sunk costs					0.206	1.310	0.203
9	Control					-0.152	-0.894	0.380

* Significant at $p < 0.001$

The analysis of the positive framed task found 63.1% of the variance in funding could be explained by the eight independent variables (perception of problem space). in the positive framed scenarios. The framing condition was significant at $F=5.122 (8,24)$., $p<.001$.

Table 6. Multiple Regression – Funding Regressed on All Eight Problem-Space Measures (Negative~ 3).

	<i>Measure</i>	<i>F</i>	<i>dfs</i>	<i>R2</i>	<i>Adjusted R2</i>	<i>Standardised beta coefficients</i>	<i>t</i>	Sig.
1	Funding	3.223*	8, 13	.665	.459			
2	Intentions					0.358	1.672	0.118
3	Risk					-0.272	-1.224	0.243
4	Disappointment					-0.329	-1.390	0.188
5	Importance					-0.104	-0.491	0.631
6	Responsibility					0.310	1.521	0.152
7	Minimise loss					0.233	1.319	0.210
8	Sunk costs					0.173	0.756	0.463
9	Control					-0.139	-0.728	0.480

* Significant at $p < 0.030$

The analysis of the negative framed task with low sunk cost found that 66.5% of the variance in funding could be explained by the eight independent variables in the positive framed scenarios. The framing condition was significant at $F=3.223 (8,13)$., $p<.030$.

Table 7. Component Matrix

	Component
	1
Close	.923
Terms	.914
Moving	.909
Given	.870

Table 8. Overall Means, Standard Deviations and Correlations (N=86).

	Variable	M	SD	1	2	3	4	5	6	7	8	9
1	Funding	50.11	26.67	-								
2	Image	17.84	6.08	.674*								
3	Intentions	3.65	.97	.300*	.188							
4	Risk	3.56	.99	-.446*	-.425*	.046						
5	Disappointment	3.29	1.12	-.310*	-.258#	-.003	.448*					
6	Importance	3.67	1.11	.081	.039	.079	.071	.286*				
7	Responsibility	3.08	1.31	.383*	.291*	-.024	-.153	.032	.333*			
8	Minimise loss	2.60	1.28	.155	.084	-.132	-.177	-.208	-.133	.005		
9	Sunk costs	3.95	1.37	.243#	.170	.316*	.106	.124	-.018	.146	-.407*	
10	Control	4.27	1.54	-.064	-.014	.048	-.045	.119	.344*	.112	.078	-.167

Significant at 0.05 level (2-tailed). * Significant at 0.01 level (2-tailed).

Table 9. Rotated Component Matrix

	Component		
	1	2	3
Sunk	.854		
Minimise	-.644*		-.321
Intention	.584		
Importance		.801	
Control		.661	
Responsibility		.651	
Risk			.830
Disappointed			.798