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PROSPECT THEORY REVISITED: INCORPORATING DECISIONMAKERS' GOALS INTO THE VALUE FUNCTION

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ABSTRACT

Prospect Theory (Kahneman and Tversky, 1979) is a highly influential theory that predicts decision making when people are confronted with choices involving gains or losses with different degrees of uncertainty. Prospect Theory argues that people are generally risk averse when it comes to seeking gains and risk seeking when it comes to seeking losses. However, Prospect Theory was originally created using hypothetical decisions. As a result, Prospect Theory has had mixed results when subject to testing in real-world decision-making contexts. One reason for this is that people tend to have goals that they are trying to achieve or outcomes they are trying to avoid when making their decisions, something Prospect Theory does not take into account. The present research investigates the effects of such goals (called "aspiration levels") and avoidance outcomes (called "avoidance levels") on decision making. As a result, we hypothesize that, for decisions involving gains, people will be risk seeking until they achieve their desired goals (the opposite of what Prospect Theory predicts) and risk averse thereafter, and for decisions involving losses, people will be risk averse until they reach their avoidance levels (the opposite of what Prospect Theory predicts) and risk seeking thereafter. These hypotheses were testing using active duty military officers (real world decision makers) making choices among military options in scenarios involving gains and losses. The officers' decisions fit the pattern predicted by our revised Prospect Theory framework. Results suggest that understanding decision making must take into account the goals of the decision maker and whether they expected outcomes of those decisions will place the decision maker in terms of aspiration and avoidance levels.

Keywords: Incorporating, Decision Makers, People, Goal, Risk

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INTRODUCTION

The present paper explores extensions to Kahneman and Tversky's Prospect Theory (1979), specifically, examining the effects of goals on the choices decisionmakers make when faced with prospects of gains and losses under different conditions of uncertainty.

Historical Perspective

These terms and concepts are those generally used in decision theory and thus have been around for over seventy years. In the late 1940's, an attempt was made to use the prescriptive theories of economics and statistics as a descriptive theory for individual choice behavior under uncertainty. Put very simply, any individual choice could be presented as a choice among two gambles:

$$\text{gamble 1} — g1 — (a1 , P1, b)$$

$$\text{gamble 2} — g2 — (c , P2, d)$$

Gamble 1, g1 thus involves a lottery in which the outcome a (which could be a prize, an amount of money, or even event) occurs with probability P1, and the outcome b occurs with probability 1-P1. Gamble 2, has an outcome c with probability P2 and an outcome d with probability (1 - P2).

Economic theory prescribes that in choosing between the options g1 and g2, a rational, economic person should compute the expected value (EV) of each option and choose that option with the higher EV:

$$EV(g_1) = P_1a + (1 - P_1)b$$

$$EV(g_2) = P_2c + (1 - P_2)d$$

Descriptive experiments quickly indicated that people clearly did not do what economic theory prescribed- -for example, consider:

$$g1 - (\$10, .5, -\$5) \qquad EV(g_1) = +\$2.50$$

$$g2 - (\$1000, .5, -\$950.00) \qquad EV(g_2) = +\$25.00$$

Most people faced with a choice between g1 and g2 would choose g1 even though the expected value of g2 is ten times as much. Further economic theory prescribes that one should be willing to pay up to $25.00 (say $20.00) for the chance to play g2. ($25.00 is called the maximum buying price of g2). The theory also indicates that anyone having the gamble should not be willing to sell it for less than $25.00 (The selling price OE g2).

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In truth, many people having g2 would be quite willing to give it away or possibly even pay someone to take it! This is because of a phenomenon known as risk aversion. People are typically risk averse and thus buy life insurance even though it has a very negative expected value.

The concept of a subjective transformation on value (which denotes "objection value", e.g. dollars) to yield the subjective value or utility of an outcome was introduced early on to explain such phenomenon as risk aversion. Consider:

g1 - ($10, .5, -$10) and

g2 - ($1000, .5, -$1,000)

These two gambles have the same expected value of zero, but most would prefer g1 to g2 if forced to choose. The concept of a marginally decreasing utility for money so that each incremental unit of value has slightly less subjective value than its predecessor is represented by a concave utility curve. A utility curve for losses such that each incremental unit of loss in value is slightly verse than its predecessor is represented by a convex utility curve for losses. Taken together as an individual's utility function over value, these curves predict choices such as g1 over g2. (Gambles g1 and g2 also have different variances, and variance outcomes has also been equated with risk.) Friedman and Savage (1948) described the utility curve of an individual that would both gamble (for relatively small amounts) and also buy insurance (against catastrophic losses).

Using such utility curves, rational, economic man was assumed to maximize expected utility (EU). For gambles g1 and g2, the expected utility of each gamble would be less than zero, the expected value of each. Further, assuming the of zero to be zero, the expected utilities of each of these gambles is less than the utility of its expected value (zero). If we denote "zero" value as "zero incremental wealth over the status quo level of wealth", then the utility curve described earlier that is concave for gains, convex for losses, would predict a choice of the sure thing status quo over either of the gambles g1 or, g2.

Further theoretical and experimental work showed that the EU theory fails to describe individual choice behavior many cases, and a subjective transformation over probability was introduced.

The experimental finding that subjects overestimated very low probabilities of large negative losses and underestimated large probabilities supported the notion of a subjective transformation S on the probability function so that the gamble g, (a P b) has as its subjectively expected utility (SEU).

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$$SEU(g1) = S(P)U(a) + S(1-P)U(b)$$

This theory, though mathematically quite general, still assumes that the S and U functions are assigned independently, whereas much of the experimental work produced dependencies between the values and probabilities –e.g., probabilities associated with high gains or extremely likely outcomes were underestimated (where objective data existed), whereas probabilities of extremely unlikely or negative outcomes (e. g., cancer) were overestimated or assessed. Thus, experimental work progressed questioning this economic theory as descriptive of decision making and thus promising in helping to predict behavior and possibly improve or aid it.

The utility theory thus far described views departures from optimal or normative economic behavior as being due to subjective transformations on the information at hand, i.e., values and probabilities. Around 1957, beginning with the work of Simon (Simon, H., 1957), a different view was promulgated, that of man as a semi-rational (some said irrational), certainly non-normative, limited information processor who had limited storage capacity, limited information processing capabilities, and limited ability to handle complexity. This thus mis-perceived the "objective" data and applied often simple decision rules or decision making. Kahneman and Tversky conducted a series of experiments predicated on this viewpoint (See Tversky, A. and Kahneman, D., 1974 and Kahneman et. al. (eds), 1982) and revealed numerous departures from normality predicted from this viewpoint. Thus began the integration of economic theory and psychological (cognitive) theory in explaining choices under uncertainty and risk. (A distinction is sometimes made between risky decision making where outcomes have defined probabilities on a well understood, event mechanism generating them and choice under uncertainty where the probability is ill-defined. For the purposes here, the two will be equated).

Around this time, a different movement also occurred in organizational theory in which the behavior of organizations began to be described as if the organization were an entity that behaved somewhat in the manner described by Simon and also Kahneman and Tversky (though they in fact came later) . Thus, Cyert and March (1963) describe the behavior of the firm in making choices and exerting control as:

- having multiple, changing goals.
- as considering alternatives in an approximately sequential manner.
- as seeking to avoid uncertainty through the use of regular procedures and reacting to feedback rather than forecasting the environment.
- using standard operating procedures and rules of thumb to make and implement choices.

Thus, the organization behaves somewhat like the decision maker postulated by Simon.

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The details of these two vast literatures will not be provided here. However, the similarities should be fairly clear, and the relevance to real-world, goal-based decision making should also be clear. Real-world decision making, unlike the hypothetical gambles described above, are often make in environments of high uncertainty and risk and are made in the context of the decision maker trying to achieve particular goals or avoid particular negative consequences. We use as a starting point Prospect Theory and discuss how it could be modified to take into account people's goals and outcomes they wish to avoid.

Prospect Theory

One of the most prominent and influential theories of decision making and choice behavior is Kahneman and Tversky's Prospect Theory (1979), which evolved from attempts to understand the place of expectation-based theories in describing individual decision making. Prospect Theory proposes a value function which relates actual outcome value to subjective utility and a decision weighting function which translates the stated probability of an outcome to a subjective weight that the stated probability carries in assessing the attractiveness of that outcome.

The value function has two distinct properties: a) it is concave for gains and convex for losses so that for example, the difference in utility between 0 and 100 dollars is not the same as the difference in utility between 100 and 200 dollars, and; b) the function for losses is steeper than the function for gains so that a given amount of loss is more aversive than the same amount of gain is attractive. The decision weighting function has the properties that very small probabilities are overweighed, while moderate and large probabilities are underweighted. Figures 1 and 2 show Prospect Theory's value function and decision weighting function, respectively.

The properties of these two functions in describing individual decisions predict that: people are risk averse when it comes to gains and risk seeking when it comes to losses.

For example, most people would rather have a sure $500 than a 50% chance to win $1000 (in fact they would even take a sure $400 to a 50% chance to win $1000) but would rather have a 50-50 chance at losing either $1000 or nothing than a sure loss of $500 (Kahneman and Tversky, 1979).

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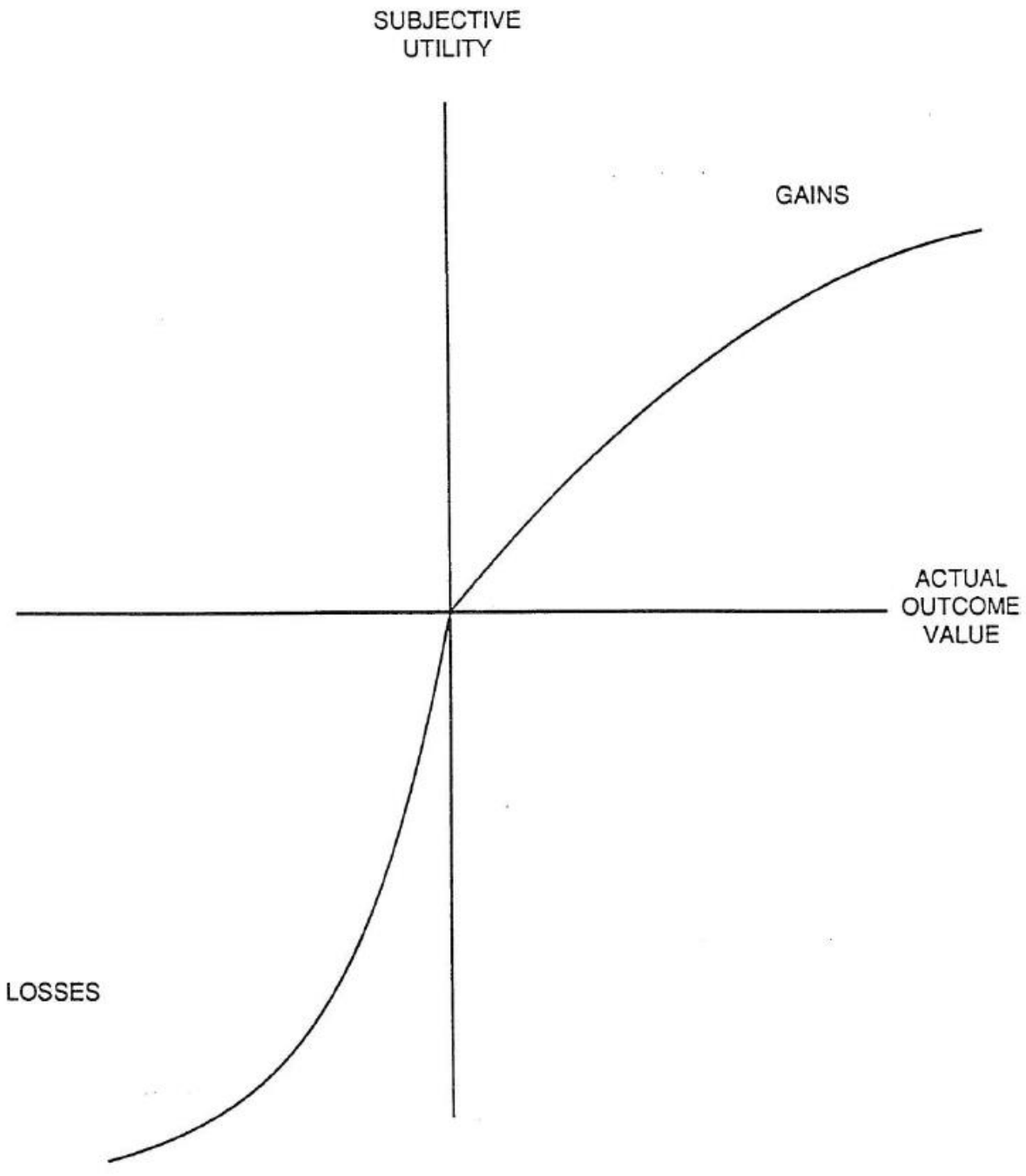

FIGURE 1. Kahneman and Tversky's (1979) value function showing relationship between actual outcome value and subjective utility.

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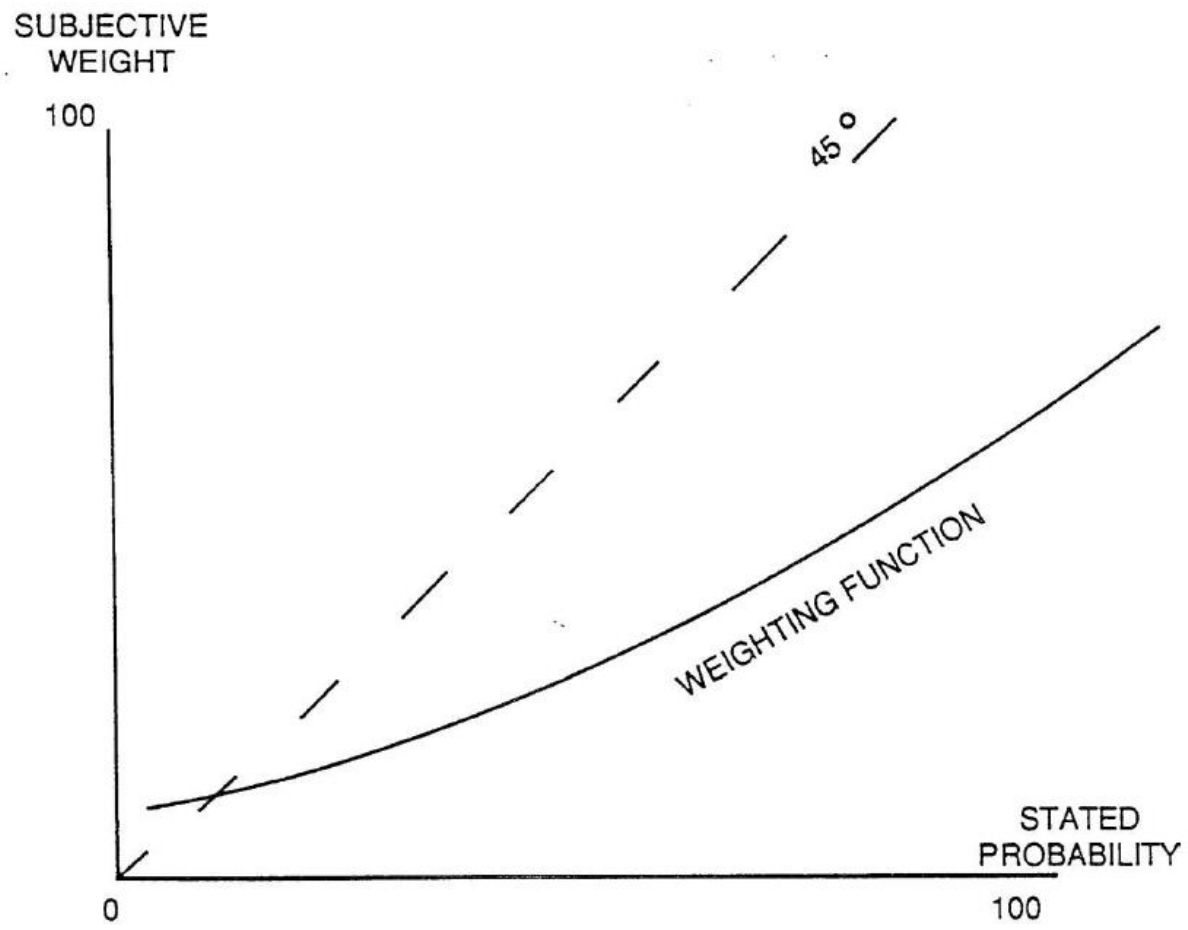

FIGURE 2. Kahneman and Tversky's (1979) decison weighting function showing relationship between stated probability of outcome and subjective probability.

One implication of Prospect Theory that is both interesting and troublesome to decision making theorists is that presenting (framing) the same pair of choices either in terms of their relative gains or their relative losses can lead the same person to pick opposite choices. In a classic example (Tversky and Kahneman, 1981), people were given a scenario which involved trying to protect 600 potential victims of a disease through one of two programs. The effectiveness of the two programs was described either terms of how people would be saved or how many people would die. Specifically, in the save version, program A would save 200 lives whereas program B had a one-third chance of saving all 600 people and a two-thirds chance of saving no one. In the mortality version, program A would result in 400 deaths whereas program B would have a one-third chance of no deaths and a two-third chance of 600 deaths. Although the two versions describe the programs' effectiveness equally, when presenting the programs in terms of lives

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saved, 72% of the subjects surveyed preferred taking the sure saving of 200 lives to gambling on the lives of all 600 people. Whereas presenting the programs in terms of lives lost, 78% of the subjects surveyed preferred risking all 600 lives to save potentially all of them as opposed to allowing people to die for sure.

A very important theoretical issue that becomes a practical issue in using Prospect Theory (or any utility formulation) to describe real-world, goal-based decisions concerns the maintaining of gains and losses. It is assumed that the decision maker considers options with respect to some reference point, say his status quo, and options are characterized as gains or losses from that status quo. Thus, in terms of preference orderings, given a series of gambles [G_1] involving gains and losses, several important issues must be clarified. If the objective gain is g, (this implies g be measured on some objective continuum) will obtain with "objective" or "stated" probability p, this means that the probability of the outcome that yields the gain g is well understood, possibly universally agreed upon as P, and the same holds true for the losses. Thus, the decision maker knows the objective probabilities. The utility (U) and probability (S) functions then represent functions which can be used to describe the results of the subjective transformation made by the decision maker on the gamble inputs (g, p, 1) so chat the subjective worth of the gamble $G_1 – (g_1, P_1, 1_1)$ is $U(g_1) = S(P_1) U(g_1) + S(1 – P_1) U(1_1)$ which is the earlier discussed subjectively expected utility theory. Prospect theory has added some very important psychological aspects to this theory by introducing gains, for the decision maker in choosing among the (G_1) looks at each G_1, from his status quo using the utility and probability functions described.

This is not a single utility function defined over some defined, invariant continuum, say total wealth (Note, the continuum could be a single vector that is a linear combination of several others thus accommodating multi-dimensional value problems. It is required that the continuum is understood to the decision maker in some way and that the utility function is defined over this meaningful continuum). Rather, the utility function is defined over losses and gains, so that when the total wealth of an individual changes, his status quo changes, and options are considered from the new reference point which becomes the new origin for the same function.

Tests of Prospect Theory

Since its inception, there have been many tests of Prospect Theory in a variety of contexts such as business and political decision making (Kahneman & Tversky, 2000; Jones 2001; Gilovich, Triffen & Kahneman, 2002; Weyland 2006). Many studies have cited support for some of Prospect Theories main claims. However, results have not always been consistent. For example, Weyland (1996) found that in Latin American countries, politicians facing economic hardships

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would sometimes enact bold, risky policies and others would enact conservative ones. Similarly, Alghalith (2012) found that investors tended to be risk seeking regardless of whether they were gaining or losing money. Riabacke (2006) examined several lumber companies. These were first grouped into established companies and new and upcoming companies. The companies were asked to choose between a new risky technology not used yet but promised to be more efficient vs the current/old technology. The established company chose the old one while the new company chose the newer technology. Thus, when confronted with the same decision, established companies were risk averse (which generally seems to be the case), whereas the newer companies were risk seeking (which generally seems to be the case).

Extension of Prospect Theory

Kahneman and Tversky have done an excellent job in explaining cases where people would be risk averse versus risk seeking and have shown how framing choices can lead to one tendency or the other. However, Prospect Theory fails to account for the real-world decisions described above. The reason for this may be reflected in the critique of Prospect Theory offered by Nwogugu (2005) that Prospect Theory was created based on hypothetical decisions that do not reflect the types of real-world decisions involving risk and reward that people typically face. In the real world, gains and losses may not be uniform in how they appear to the decision maker.

The present study addresses this issue and extends the framework of Prospect Theory to the situations where people have stated goals they are trying to achieve or outcomes they are trying to avoid, thus examining decisions that may more realistically reflect real-world choices.

Specifically, Prospect Theory is extended by refining the value function to take into account the goals of the decision maker. It is argued that real life choices involve decisions whose outcome are related to the goals of the person making that choice. Examples, of these goals are outcomes a decision maker is trying to attain and outcomes a decision maker is trying to avoid. These we will label the aspiration level and the avoidance level as illustrated Figure 3.

Consider the Prospect Theory's value function once aspiration and avoidance levels have been incorporated. A person striving to become a millionaire will value the one-millionth dollar earned more than s/he will the second dollar earned. In fact, each successive dollar earned gains in importance as it brings the person closer to the goal of becoming a millionaire. Similarly, in a race, finishing first instead of second is valued more highly than finishing 99^{th} instead of 100^{th}. This is the opposite of what is predicted by Prospect Theory.

On the other hand, once the person has achieved his or her goal of having $1,000,000, each successive dollar becomes increasingly less important (unless the person updates the goal to achieve more money). Accordingly, once the aspiration level has been attained, the value

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function reverts to the shape proposed by Prospect Theory. As a result, the revised value function for gains is convex for gains between the current level and the aspiration level and concave for gains above the aspiration level.

A similar argument can be made for losses. If a company is losing money and risks going bankrupt (an avoidance-level outcome), each successive dollar lost becomes increasingly important. Thus, we would expect to see, and we do in the real world, companies becoming increasingly conservative, rather than risky, as losses mount. This is the opposite of what Prospect Theory predicts. On the other hand, once the avoidance level is reached, we would expect the company to be willing to take risks to undo the losses. We see this expressed in sayings such as "nothing left to lose." As a result, the revised value function for losses is concave for losses between the current state and the avoidance level and convex for losses beyond the avoidance level.

The revised value function can be reconciled with the Prospect Theory one. If we take out the portion of the function between the avoidance level and the aspiration level, we see a value function that is the same as that in Prospect Theory. Since Prospect Theory was developed using abstract gambles where no goals (positive or negative) were explicitly stated, it is reasonable that the portion of the function between the avoidance and aspiration levels would be omitted from Kahneman and Tversky's work. The present reformulation takes into account the existence of real-world goals and modifies the value function accordingly.

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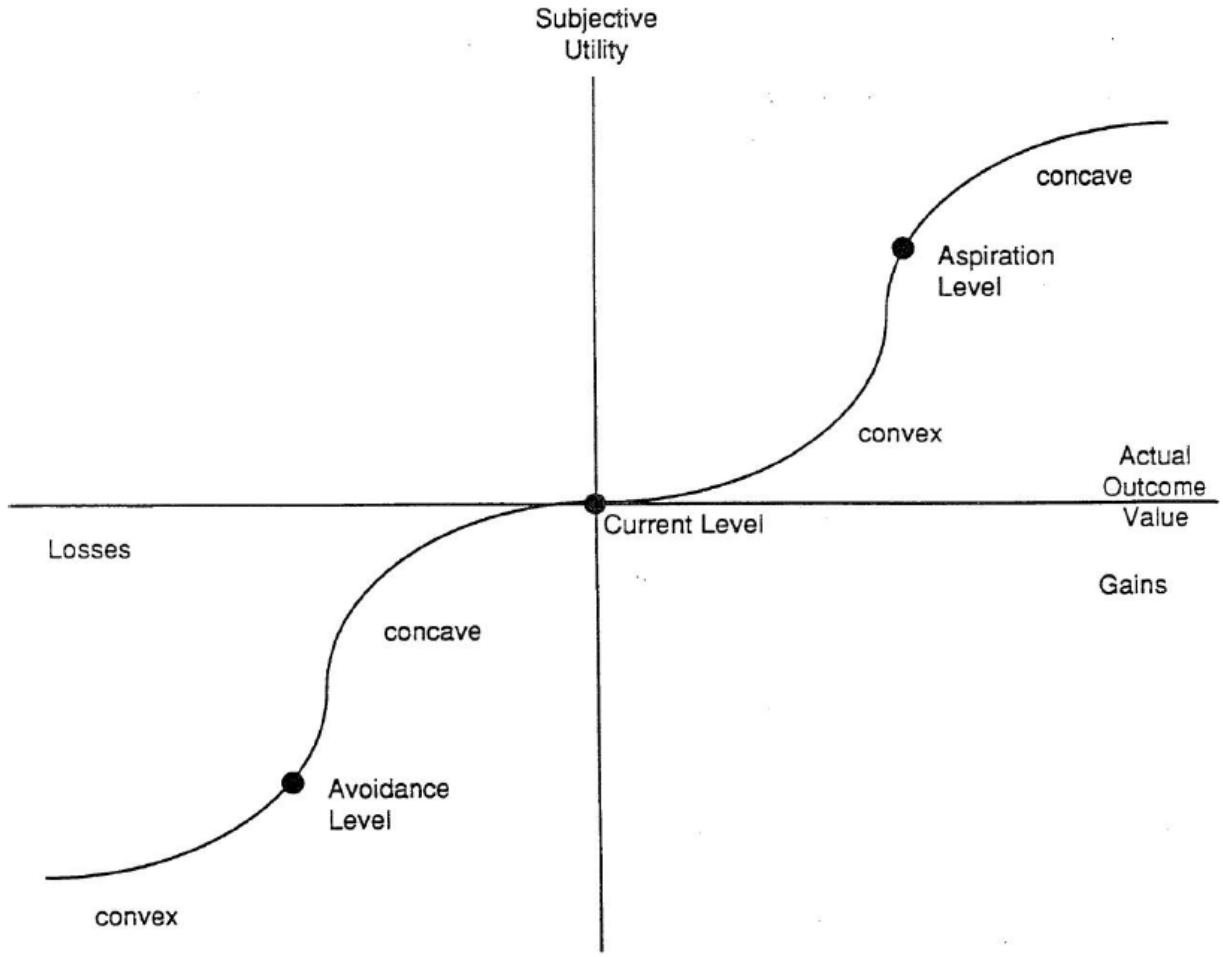

FIGURE 3. A value function showing aspiration and avoidance levels as reference points.

Framing effects and attitudes toward risk. As discussed earlier, Tversky and Kahneman (1981) showed that people will often make different choices regarding the same set of options depending upon whether they view those choices in terms of gains or losses. It is argued that a similar effect will occur depending upon whether they are view those choices in terms of outcomes above or below the aspiration and avoidance levels. In fact, it is argued that people will use the aspiration and avoidance levels to frame decisions spontaneously. Figure 3 presents a revised value which is in essence the Prospect Theory function with two reference points instead of one.

When one's current level lower than one's aspiration level for gains, it is hypothesized that people naturally frame their decision terms of losses (e.g., “I’m less than where I want to be.”).

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Here, the value function is convex as is illustrated in Figure 3. Hence, one should be risk seeking in those situations since increases in gains (reduction of loss from the aspiration level) are valued more highly than decreases in gains (increases in losses from the aspiration level) for that part of the curve. The amount of risk seeking should depend on the distance between the current level and the aspiration level: the smaller the distance, the greater the risk seeking due to the convexity of the function.

If a person's current level is equal to or above than the aspiration level, it is hypothesized that this person will spontaneously frame his or her decision in terms of further gains (since the goal is already reached). Here, the value function is concave. Hence, one should be risk averse further increases in gains diminish in value the farther the person gets above the aspiration level. The amount of risk aversion should also depend on the distance between the current level and the aspiration level: the lesser the distance (and hence the closer one is to falling below the aspiration level), the greater the risk aversion due to the concavity of the function.

When faced with losses, and a person's current level is greater than the avoidance level, then is hypothesized that this person will naturally frame his or her decision in terms of losses (to avoid reaching the avoidance level). Here, the value function is concave. Hence, one should be risk averse in those situations since the positive of decreasing one’s losses should be less than the negative utility of increasing one's losses. The amount of risk aversion should depend on the distance between the current level and the avoidance level: the smaller the distance, the greater the risk aversion due to the concavity of the function.

If a person's current level is equal to or below the avoidance level, it is hypothesized that this person will naturally frame his or her decisions in terms of gains (to get above the avoidance level). Here, the value function is convex. Hence, one should be risk seeking since the positive subjective utility of decreasing one's losses should be greater than the negative subjective utility of increasing one's losses. The amount of risk seeking should also depend on the distance between the current level and the avoidance level: smaller the distance, the greater the risk seeking due to the convexity of the function.

The threshold nature of the aspiration levels and avoidance levels leads to systematic effects on framing of expectations. As people move closer to their avoidance level, it is proposed that in some cases, the absolute value of this level increases so that people mentally prepare themselves for bigger losses while accommodating current losses. This hypothesis is consistent with findings by Loewenstein and Linville (1986) who find that people lower their expectations as the possibility of a loss approaches. This is also similar to the adaption level discussed by Helson as early as 1948 (Helson, H, 1948). This cognitive shifting of the avoidance level would reduce risk aversion in loss situations because the magnitude of the loss the decision maker is willing to

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accept is increasing. These two effects should occur in domains where outcome level a continuous variable such as money. In other situations where outcome can be viewed as a threshold type, dichotomous variable e.g. graduating from college versus not graduating, winning a game versus losing, the aspiration and avoidance levels should not change over time. Other situations may have aspiration level that evolve over time as people change their goals in response to different outcomes. For example, companies that meet certain sales figures during the year may revise those figures. The United States Congress sets a debt ceiling to specify maximum allowable national debt (presumably, an avoidance level), but it continually modifies that ceiling every time it is reached.

The reformulated value function is useful in explaining the empirical results described earlier that appear at odds with the original version of Prospect Theory. For example, investors presumably have a very high aspiration level, so it makes sense for them to be risky as they are gaining money since they would be below whatever aspiration level they set. Since their goal is to make money, any loss would be below the avoidance level, which would also predict risky decision making.

For the lumber companies, new companies have not yet established themselves. Therefore, we would expect new companies to be below their aspiration levels and be willing to engage in risky behaviors. On the other hand, an “established” company has already achieve the goal of becoming successful (its aspiration level), so we would expect to see it to be more risk averse in decision making.

The revised value function is useful in explaining apparent discrepancies in economic policies. For example, when countries show modest economic declines, they often enact austerity programs (e.g., Greece in recent years or the sequester in the US) that are marked by reduced government spending and attempts to reduce debt. On the other hand, severe economic downturns (e.g., the Great Depression in the 1930’s or the Great Recession in 2008 in the US) are often marked by bold economic initiatives like high government spending, new programs (e.g., the New Deal during the Great Depression), and incurring large amounts of debt. This apparent contradiction can be explained using the avoidance level. As long as the economy has not reached disastrous conditions (the avoidance level), governments are risk averse, but once those levels are reached, they become risk seeking.

Hypotheses to be tested

The present paper investigates portions of the above theoretical framework that relate to the value function. Of interest is decision making in “gain" situations where potentia1 outcomes are either above or below the aspiration level and "loss" situations where potential outcomes are

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either above or below the avoidance level. The results of the present study will have implications for the shape of the value function in the proposed revised Prospect Theory.

There are five specific hypotheses to be tested in the present paper. Hypothesis 1 concerns choices among potential gains when the current level is below the aspiration level. It is hypothesized that decision makers will prefer a gamble that has a 50-50 chance of either reaching the aspiration level or making no progress to a sure gain equivalent to half the distance between the current level and the aspiration level. This is the opposite of what is predicted by Prospect Theory.

Hypothesis 2 concerns choices among potential gains when the current level is at the aspiration level. It is hypothesized that decision makers will prefer a sure gain over a gamble that has a 50-50 chance of no gain or a gain that is twice the size of the sure gain. This is what Prospect Theory predicts in cases where no stated goals or aspiration level is present.

Hypothesis 3 concerns choices among potential losses when the current level is above the avoidance level. It is hypothesized that decision makers will prefer a sure loss equivalent to half the distance between the current level and the avoidance level over a gamble that has a 50-50 chance of no loss or a loss that puts decision makers at the avoidance level. This is the opposite of what is predicted by Prospect Theory.

Hypothesis 4 concerns choices among potential losses when the current level is at the avoidance level. It is hypothesized that decision makers will prefer a gamble that has a 50-50 chance of either placing the decision maker above the avoidance level or incurring further losses to an option with a sure outcome of remaining at the avoidance level. This is what Prospect Theory predicts in cases where no stated goals or avoidance level is present.

Hypothesis 5 concerns the relative magnitude of the effects for gain and loss situations. Both Kahneman and Tversky's (1979) Prospect Theory and the current framework hypothesize that the value function is steeper for losses than it is for gains. Therefore, the shift from risk seeking to risk aversion should be greater as decisions shift from involving outcomes below and above the avoidance level versus below and above the aspiration level. In other words, the effects for hypotheses 3 and 4 are hypothesized to be greater than the effects for hypotheses 1 and 2.

METHOD

Participants

55 military officers served as participants in the present study. Participants ranged in rank from Chief Warrant Officer 2 (CW2) to lieutenant colonel (LTC). All participants were active duty

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officers from either Ft. Carson, Ft. Polk or Ft. Hood in the United States. Participants were from a variety of branches including combat arms, military intelligence (MI) and combat support.

Military officers were chosen as these are real-world decision makers who make decisions involving gains or losses that involve risk and uncertainty where aspiration levels (winning a battle) or avoidance levels (losing a battle) can be explicitly defined.

Materials Used

Six problems were constructed in paper and pencil format. The first four problems represented abbreviated military scenarios involving a Russian threat in Germany. In each of these problems, participants were asked to role play the commanding general. The last two problems represented choices among monetary gambles and thus represent scenarios similar to those used by Kahneman and Tversky in Prospect Theory.

In problem 1, the participants were told that they were on the offensive (after initial defensive operations) and stood some sixty kilometers from the German border after a successful Russian invasion. They were given two courses of action to chose from, one that achieved 30 kilometers for sure, and one that had a 50-50 chance of making no progress or reaching the German border. Partners were instructed that reaching the German border was equivalent to winning the war (which was their assumed aspiration level).

In problem 2, the participants were told that they were on the defensive and stood some sixty kilometers from the Atlantic Ocean ports. They were given two courses of action to choose from: pulling back and giving up 30 kilometers and holding thereafter for sure; and defending the current position with a 50-50 chance of successfully holding the position or allowing a penetration that would enable the enemy to seize that Atlantic ports. Participants were instructed that allowing the enemy to seize the Atlantic ports was equivalent to losing the war (which was their assumed avoidance level).

In problem 3, the participants were told that they were on the offensive (after initial defensive operations) and stood on the German border. The enemy was suing for peace and the friendly forces were looking to strengthen their bargaining power. Participants were given two courses of action to choose from, one that achieved seizing 30 kilometers of enemy territory for sure, and one that had a 50-50 chance of making no progress or seizing 60 kilometers.

In problem 4, the participants were told that they were on the defensive and were pushed back and lost the Atlantic Ocean ports. Surrender by the friendly forces was imminent. Participants were given two courses of action to choose from: surrender for sure or counterattack with a 50-

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50 chance of successfully regaining the ports and continuing to fight or being defeated and incurring new enemy retaliatory initiatives.

Problem 1 was constructed to test hypothesis 1; Problem 3 was constructed to test hypothesis 2; Problem 2 was constructed to test hypothesis 3; and problem 4 was constructed to test hypothesis 4. The remaining two problems were constructed to replicate Prospect Theory's findings that decision makers are risk averse with respect to gains and risk seeking with respect to losses for gambles with no explicit aspiration level or avoidance level.

In problem 5, participants were offered a (hypothetical) choice of a sure $500 or a 50-50 chance of $1,000 or nothing. In problem 6, participants were offered a choice of a sure loss of $500 or a 50-50 chance or no loss or a loss of $1,000.

Procedure

All six problems were administered in paper and pencil format the order described above. Participants were instructed to read through each problem sequentially and choose the option that appealed to them. Participants were instructed to treat the probability information (i.e., "sure thing" and "50 – 50") as reliable. Post-session discussions indicated that participants did so.

Participants were allowed to work at their own pace and were assured that there were no "right or "wrong" answers to the problems -- that it was merely a survey of preferences.

RESULTS

Of the 55 participants used in the present study, one circled both options on one of the problems, therefore making the data for that problem unusable. The fact that the participant did that for one problem calls into question whether he understood the procedure. Therefore, all data from that participant is excluded from the analysis, leaving 54 observations for each problem.

Table 1 presents the number of participants who selected the sure thing outcome (risk averse) and the gamble (risk seeking) for each of the six types of problems. The "monetary" problems were those designed to replicate the Kahneman and Tversky findings.

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Table 1

Number of Participants Choosing Sure Thing and Gamble for Each Type of Problem

Monetary Problems	Sure thing	Gamble
Gain	36	18
Loss	10	44

Replicates Kahneman and Tversky

Military Problem	Sure thing	Gamble
Gain		
Below Aspiration Level	21	33
Above Aspiration Level	33	21
Loss		
Above Avoidance Level	39	15
Below Avoidance Level	7	47

As can be seen from Table 1, the monetary problems did indeed replicate the Kahneman and Tversky findings. When choosing among a sure $500 and a 50-50 chance at $1,000 or nothing, 36 of 54 or two-thirds of the participants chose the sure thing. Participants in this problem were risk averse as in the Kahneman and Tversky findings (Z - 2.31, P - .01).

Similarly, when choosing among a sure loss of $500 or a 50-50 chance at a loss of $1,000 or no loss, 44 of 54 or 81% chose the gamble (Z - 4.49, P<.001) . Participants in this problem were risk seeking as in the Kahneman and Tversky findings. These two results suggest For the pure monetary gambles, military offices behaved identically to participants in the original Prospect Theory studies, i.e., were risking averse for gains and risk seeking for losses. The trend was even stronger for losses, as predicted in Prospect Theory. This suggests that the military officers used in the present study were generally neither more nor less risk seeking than the general population.

However, when outcomes are described relative to an aspiration level or an avoidance level which is more like a real-world decision-making scenario, the results are different from the standard Prospect Theory findings and are consistent with the proposed extension of Prospect Theory.

For gains where the current level is below the aspiration level, 33 of 54 participants or 61% chose the gamble that had a 50-50 chance of reaching the aspiration level or no gain over a sure gain below the aspiration level compared to 39% who chose the sure gain (Z = 1.50, P = .034,

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one-tailed). This supports hypothesis 1 and suggests that participants are risk seeking for gains below the aspiration level.

On the other hand, for gains above the aspiration level, 33 of 54 participants (61%) chose the sure gain over a 50-50 chance to get a larger gain or no gain ($Z = 1.50$, $p = .034$, one-tailed). These participants had become risk averse, thus supporting hypothesis 2.

One way to validate that participants are risk seeking for gains below the aspiration level and risk averse for gains above the aspiration level is to look at their individual data. Of the 54 participants, 10 were risk averse for both types of problems and 10 were risk seeking for both types of problems. The participants of most interest, however, are those who were risk seeking for gains below the aspiration level and risk averse above and those who showed the opposite tendency, namely, risk averse below and risk seeking. Of the 34 remaining participants, 23 showed the expected pattern, while only 11 showed the opposite pattern. This difference is statistically significant using a binomial distribution that assumes an equal probability $p = .029$, one-tailed.

For losses above the avoidance level, 39 of 54 participants (72%) chose the sure loss above the avoidance level over a gamble that had a 50-50 chance of either reaching the avoidance level or leading to no further losses ($Z = 3.13$, $p < .001$). This supports hypothesis 3 and suggests that participants were risk averse for losses above the avoidance level.

For losses below the avoidance level, 47 of 54 participants (87%) chose the gamble that had a 50-50 chance of either moving above the avoidance level or sinking even further below it over remaining at the avoidance level for ($Z = 5.31$, $p < .001$). This supports hypothesis 4 and suggests that participants were risk seeking for losses at or below the avoidance level.

Again, a comparison can be made at the individual level to examine the tendency for participants to exhibit the predicted affects. Of the 54 participants, 7 were risk averse for both problems and 15 were risk seeking for both problems. Again, the participants of most interest are those who were risk averse for losses above the avoidance level and risk seeking below and those who showed the opposite tendency, namely, risk averse below and risk seeking above. Of the 32 remaining participants, all showed the expected pattern. This difference is statistically significant using a binomial distribution that assumes and equal probability for each pattern, $p < .0001$.

These results support the four major hypotheses regarding the extension of Prospect Theory with regard to the value function. Specifically, these results support the contention that the value function is convex for gains between the current level and the aspiration level (thus leading to risk seeking behavior) , concave for gains above the aspiration level (thus leading to risk averse behavior), concave for losses between the current level and the avoidance level (thus leading to

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risk averse behavior), and convex for losses below the avoidance level. Alternately, these results support the three-reference point version of Prospect Theory that differentiates between goal directed, risky choices, and non-goal directed choices.

The fifth hypothesis to be tested in the present study is that the shift between risk aversion and risk seeking around the avoidance level is greater than that around the aspiration level, suggesting that the value function is steeper for losses rather than gains. The general pattern of data bears this trend out. Specifically, for gains, whether the outcomes lie above or below the aspiration level produces a swing of 22% in the number of participants who prefer a sure gain over a gamble (39% for gains below the aspiration level and 61% for gains above the aspiration level). On the other hand, for losses, whether the outcomes lie above or below the avoidance level produces a swing of 59% in the number of participants who prefer a sure loss over a gamble (13% for losses below the avoidance level and 72% for losses above the avoidance level).

An additional test of this effect involves looking at the individual participants' data. In particular, one can look at the number of participants who tended to move toward versus away from the hypothesized effects for both losses and gains. Table 2 below presents a matrix of the participants who shifted in the direction of the hypothesis, away from it or stayed the same (i.e., picked the sure outcome or the gamble in both of the gain or loss problems) by type of problem gain or loss.

Table 2

Number of Participants who Moved in Direction Toward or Away from the Predicted Effect or Made a Consistent (same) Choice.

	Gain Problems		
	Opposite Effect	Predicted Effect	Same
Loss Problems			
Opposite Effect	0	0	0
Predicted Effect	6	15	11
Same	5	8	9

Of interest in Table 2 is the number of participants who either shifted in the hypothesized direction (moved from risk averse to risk seeking as outcomes go below the aspiration or avoidance level) for one type of problem (gain or loss) while remaining the same (risk averse or risk seeking) or moving opposite the hypothesized direction (i.e., moving from risk seeking to risk averse as outcomes go below the aspiration or avoidance level) for the other type of problem

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(loss or gain) and the number of participants who remained the same for one type of problem while moving away from the hypothesized direction for the other type of problem.

In other words, of interest is the participants who more closely matched the hypothesis for losses than for gains versus those who showed the opposite effect. More closely matching the hypothesis could be accomplished by either having the participant show the hypothesized effect for losses but not for gains or by having a consistent strategy for losses (either risk seeking or risk averse) but a strategy that was opposite to the hypothesis for gains i.e., risk seeking above the aspiration level and risk averse below) .

The opposite effect to hypothesis 5 would occur when the participants were closer to the effects predicted by hypotheses 1 and 2 than they were to 3 and 4. This would happen when the participant either showed the hypothesized effect for gains but not for losses or by having a consistent strategy for gains (either risk seeking or risk averse) but a strategy that was opposite to the hypothesis for losses (i.e., risk seeking for losses above the avoidance level and risk averse below).

We look at each of these components (i.e., participants whose choices tended to be consistent with hypothesis 5 versus those who were the opposite) by examining the data in Table 2. Table 2 shows that there were six participants who showed the hypothesized effects for losses but showed the opposite effects for gains, eleven who showed the hypothesized effects for losses but were consistent in their gain strategy (either always risk averse or risk seeking), and five who used a consistent strategy for losses but showed opposite the hypothesized effects for gains. The total of these three cells is 22--the number of individual participants whose choices were in the direction predicted by hypothesis 5.

For those who went against the hypothesis, there were eight participants who showed the predicted effects for gains, but used a consistent strategy for losses. There were no participants who showed the opposite effects that were hypothesized for losses (risk seeking above the avoidance level and risk averse below).

Therefore, in the individual data, there were 22 participants whose results tended to go in the direction of hypothesis 5, while there were eight whose results went in the opposite direction. This difference is statistically significant using a binomial test, p =. 008, one-tailed. Thus, the individual data provided additional support for hypothesis 5.

DISCUSSION

The data provide overwhelming support of the proposed extension of Prospect Theory to goal directed decision making. Specifically, the results suggest that the value function is convex for

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gains between the current level and the aspiration level (thus leading to risk seeking behavior) and concave for gains above the aspiration level. The results also suggest that the value function is concave for gains between the current level and the avoidance level and convex for gains below the avoidance level. The present results also confirmed Prospect Theory's contention that the value function is steeper for losses than for gains.

As discussed in the introduction section, the present reformulation of Prospect Theory's value function to one involving three reference points can be reconciled with the original Prospect Theory value function by taking into account that the latter did not take specific goals into account. If there are no aspiration and avoidance levels, then the revised value function would collapse into the original value function.

The revised value function can be a useful tool in understanding the types of decisions people will make in situations involving gains and losses when they have actual goals they are trying to achieve or outcomes they are trying to avoid. Arguably, this is more common in real life than the abstract and hypothetical situations presented in the original version of Prospect Theory.

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