*Int. J. Environ. Res., 3(3):379-394, Summer 2009*
*ISSN: 1735-6865*

**Review Paper**

# A Review of the Implications of Prospect Theory for Natural Hazards and Disaster Planning

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Received 10 Jan. 2009; Revised 17 March 2009; Accepted 25 March 2009

**ABSTRACT:** Traditional approaches for environmental hazards and disaster planning under conditions of risk and uncertainty are discussed, including normative expected utility theory, "satisificing", and robustness analyses. Prospect theory, a descriptive technique with roots in psychology, has emerged as an alternative theory of decision making under risk and uncertainty to utility theory and other classic approaches. Over the past quarter century Prospect theory has been increasingly used in various disciplines such as political science, public health, engineering, economics, insurance, and business. This paper aims to introduce and discuss some of the potential implications of prospect theory for environmental hazards and disaster planning theory and practice. It is argued that prospect theory can significantly enhance environmental hazards and disaster planning theory and practice, particularly for decision making under uncertainty. Several practical examples are provided to illustrate the strengths of this versatile method.

**Key words:** Prospect theory, Environmental hazards, Disaster planning, Planning theory, Decision making, Risk,Uncertainty

## INTRODUCTION

Natural hazards and disaster planning is a systematic, goal-directed decision-making process requiring the evaluation of alternative courses of action often under uncertainty, "including the consequences of present choices for alternative goals in the future" (Goodall, 1987). Planning under uncertainty and risk is essential in all hazards and disaster planning fields including urban and regional disaster planning. For example, in urban and regional planning, there are high levels of uncertainty related to land use management (i.e. zoning, public facility location), transportation options, urban redevelopment, urban design, conservation of the built environment, and community development. Environmental hazards planners from all levels of government, from local to national, must make decisions under uncertainty. It follows that uncertainty is a defining characteristic of urban and regional planning and decision making processes, particularly in environmental hazards and disaster planning activities that involve coordinated efforts among governments, private individuals and corporations. Decision making processing for hazards and disaster planning have been influenced by research contributions in many fields, including political science, economics, social psychology, and organizational behavior. Hazards and disaster planning theorists attempt to provide theoretical

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understanding and prescription for hazards and disaster planning using baseline theories in the social sciences and humanities. By so doing, the hazards planning field has become richer due to the infusion of new theories and ideas (Faludi, 1973, 1978, 1982, 1986, 1989, 1994, 1996; Beauregard, 1989; Pennington, 1996; Sandercock, 1998; Friedmann, 1987; Forester 1980, 1989, 1993, 1996; Innes 1995; Healey 1993, 1997; Allmendinger, 2002). This search for new theories and their practical implications is a continuous, valuable, and necessary process in environmental hazards and disaster planning (Huxley, 2000). *Prospect theory*, first formulated by Kahneman and Tversky (1979, 1992) is herein proposed as a viable theoretical foundation for hazards and disaster planning under conditions of risk and uncertainty. Moreover, as a descriptive theory, it may be better able to predict how planners make decisions in real-world situations than well-established normative techniques.

Kahneman and Tversky recognized the limitations of expected utility theory model: it could not systematically and comprehensively describe, predict or explain the manner in which individuals make decisions under uncertainty. For example, they pointed out that expected utility theory does not explain the manner in which the framing of a decision problem can change an individual's choice, nor does it explain why individuals exhibit risk-seeking behavior in some instances and risk-averse behavior in others. Prospect theory has been applied with enormous success to applications in business, economics, finance, law, medicine, and political science (e.g. McNeil *et al.*, 1988; Levy, 1989, 1992, 1994, 1996, 1997; McDermott, 1998, 2004; Jolls *et al.*, 1998; Barberis *et al.*, 2001). Accordingly, it is useful for hazards and disaster planning theorists and practitioners to explicitly explore and examine the uses and implications of this promising and influential theory. Traditional approaches for decision making under uncertainty include expected utility theory and "bounded rationality"(Simon, 1955) as described in Section two. Here, the weaknesses of these traditional decision making approaches for hazards and disaster planning are discussed. Section three briefly describes prospect theory and its decision model. Section four provides a framework for linking prospect theory with environmental hazards and disaster planning theory and practice. Section five explains some of the major implications of prospect theory for hazards and disaster planning. Finally, section six concludes the paper with a discussion and suggestions for future research directions.

## Traditional Approaches for Environmental Hazards and disaster planning Expected Utility theory

The history of utility theory spans nearly 300 years due to contributions from gambling by Bernoulli in 1738, economics by von Neumann and Morgenstern (1947), statistics by Savage (1954), psychology by Tversky and Kahneman (1987), and measurement theory by Siegel (1956) which is often used to assign numbers to objects and observations in the hazards and disaster planning process. Utility theory can aid planners by systematically including their values and beliefs, including quantitative preference representation. The first general theory of expected utility for preference was outlined by Frank Ramsey in 1926 and published posthumously (Ramsey, 1931). Since the end of the Second World War, von Neumann-Morgenstern (1947) Expected Utility (EU) has been widely accepted by planners as the normative standard for decision making under risk and uncertainty. Although von Neumann and Morgenstern (1947) did not mention Ramsey, Savage (1954) drew heavily on both the seminal work of von Neumann and Morgenstern (1947) and Ramsey to develop subjective expected utility theory (SEU), which extends EU theory in circumstances where the probabilities are not provided. EU theory begins with a set of axioms relating to the planner's preferences among risky alternatives: the theoretical underpinnings of EU theory are well-known and have been described in depth elsewhere (Luce and Raiffa, 1957).

EU theory has been the preeminent model for rational decision making since the middle of the twentieth century, and the notion that a planner attempts to "maximize" her preferences is intuitive. However, the conditions required for classic EU theory, seldom, if ever, exist in real world environmental hazards and disaster planning problems: full knowledge of the hazards and disaster planning alternatives, project costs, and objective utility. These assumptions are simply unrealistic and EU theory has been widely

criticized by planners, economists, decision analysts and others. There is a broad consensus emerging among planners that the *descriptive* value of EU theory is limited. A central issue in this popular decision making paradigm involves the planner's risk profile (risk seeking, risk neutral, or risk averse).

**Satisficing and Bounded Rationality**

There are many important phenomena observed in the decision making of planners that are not explained by the utility theory. Nobel Laureate Simon's (1955) concept of "satisficing" (a combination of the words satisfactory and sufficient) maintains that people are able to process relatively little of the information available to them. Specifically, March and Simon (1958) note that satisficing involves a "bounded rationality" in that decisions occur in limited time frames and decision makers are not aware of (and unable to acquire) all of the information required to make a decision. The term 'bounded rationality' implies "somewhat less than perfect rationality". A planner who selects the best available alternative according to a specific criterion is said to optimize; a planner who chooses an alternative that meets (or exceeds) specified criteria, is said to "satisfice". Optimization may be misguided in environmental hazards and disaster planning situations characterized by extreme uncertainty, highly non-linear relationships, turbulent dynamics and changes in the preferences of key planners over the strategic time horizon. Specifically, many environmental hazards and disaster planning decisions involve investments in technology over more than a decade during which changes in technology, funding, and leadership are likely to occur. Planners may satisfice due to the inherent complexity of both the optimization process and many real-world environmental hazards and disaster planning situations.

The approach of bounded rationality recognizes that decision makers are not completely rational in terms of traditional EU theory. Of course, the satisficing solution is not guaranteed to be either unique or in any sense "best". For many planners, a solutions that is as close as possible to a goal is more acceptable than an optimal one: planners routinely reject apparent optimal solutions for those that provide a minimum standard of satisfaction, often referred to as "aspiration levels". Moreover, in the real-world environmental hazards and disaster planning process, both firms and individual decision makers rarely examine all alternatives or pay attention to all potentially relevant variables. The notion that planners use *heuristics* to guide them when faced with a complex problem is inspired by the idea of satisficing.

**Flexibility and Robustness**

The notion of satisficing and bounded rationality has inspired planners to search for increased flexibility, robustness, and adaptability in their decision making. Applications range from water resources hazards and disaster planning and management ("safe-fail systems") to financial hazards and disaster planning (portfolio hedging and asset liquidity). The robustness concept implies a different hazards and disaster planning paradigm than traditional optimization techniques, including cost-benefit analysis and return-on-investment approaches. A robustness approach will not provide the "optimal" answer; rather it offers insights that can lead to more adaptive and flexible environmental hazards and disaster planning strategies. Furthermore, robustness and flexibility implies a participatory, process-oriented approach to strategic hazards and disaster planning as decision robustness is evaluated at each stage of the hazards and disaster planning process.

To some planners, robustness is conceptualized as a counterpart to risk: robustness represents desirable variability in a decision process as opposed to the undesirable variability implied by riskiness. Lindblom (1959) advocates using robustness to hedge against uncertainty by making incremental hazards and disaster planning decisions since "decision makers prefer incremental improvement over optimal solutions". Robustness may be viewed as an insurance policy against uncertainty for planners. However, unlike a traditional insurance policy, robustness is almost certain to pay off, but the amount of the payoff is not guaranteed. Robustness analysis "abandons the search for optimality" in an unknowable future in favor of "the more modest goal of future flexibility." Rosenhead et al. (2001) introduced the notion of robustness in the strategic environmental hazards and disaster planning and decision making literature.

A robust plan should be able to cope with rapidly changing circumstances and respond to

unexpected outcomes. The field of environmental hazards and disaster planning is changing so rapidly (new policies, unanticipated outcomes, changing technical characteristics of urban systems, etc) that planners are increasingly turning to flexibility and robustness analysis. For example, there is a large literature in the context of environmental hazards and disaster planning and robustness. Specifically, Kundzewicz (1997) notes that robust and adaptive environmental solutions are required to deal with the impact of human activities on the earth (resource exploitation, pollution, overpopulation, etc).

**Prospect Theory**

As a descriptive technique, prospect theory explains how individuals choose among alternatives when outcomes associated with those alternatives are probabilistic or uncertain in nature. By investigating anomalies and contradictions in human behavior, Kahneman and Tversky (1979, 1992) concluded that psychological factors influence choices under uncertainty and were often able to capture departures from rational models: they challenged the explicit rules of rational decision making theory by noting that choices that individuals make under situations of risk and uncertainty exhibit several characteristics that are inconsistent with the fundamental von Neumann-Morgenstern (1944) expected utility principles.

They argued that, for example, individuals underweight probable outcomes in comparison with outcomes that are certain. They called this phenomenon the certainty effect. They also pointed out that the certainty effect brings about risk-aversion in choices involving certain gains and risk-seeking in choices involving certain losses (Kahneman and Tversky, 1979). This means that people weight losses heavier than gains and because of that they prefer status quo. They also found that individuals facing a choice among different prospects disregard components that are common to all prospects under consideration. They termed this commonality the framing effect. The framing effect, they argued, will cause the framing of a prospect to change the choice that the individual decision-maker makes. A third element of the decision-making process that discovered was the reference point effect, which is whether decision outcomes are viewed as gains or losses relative to a psychologically neutral reference point. Decision outcomes that are perceived to fall below the reference point are viewed as potential losses and conversely, outcomes that are perceived to exceed the reference point are seemed as gains. Accordingly it is argued that choice depends on the reference point and changes in the reference point may cause preference reversals.

The first element of prospect theory involves a value function, v($x$), in which x is the change in wealth (gains or losses) with respect to some reference point, this function being concave for gains and convex for losses and describing a diminishing sensitivity towards an increase in gains or losses. The second element of prospect theory is a probability weighting function $w(p)$ that describes probability distortion by transforming given probabilities into decision weights (Baucells and Heukamp, 2004). Formally, a prospect consists of a set of outcomes, $x_i$, with associated probabilities, $p$i. In a simple cumulative form, prospect theory specifies the following expected valuation expression, $\sum_{i=1}^{n} v(x_i)\, w(p_i)$, where $v(x)$ is concave over gains (positive $x$) and convex over losses (negative $x$), and $w(p)$ is a nonlinear weighting function and n is the possible number of outcomes. Tversky and Kahneman (1992) used the following empirical value function to estimate parameters:

$$v(x) = \begin{cases} x^{\alpha} & \text{if } x > 0, \\ -\lambda(-x)^{\beta} & \text{if } x < 0. \end{cases}$$

Parameter estimation based on experimental results leads to $\alpha = \beta = 0.88$ and $\lambda = 2.25$. The probability weighting function for gains can be described by:

$$w^{+}(p) = \frac{p^{\gamma}}{(p^{\gamma} + (1-p)^{\gamma})^{\frac{1}{\gamma}}}$$

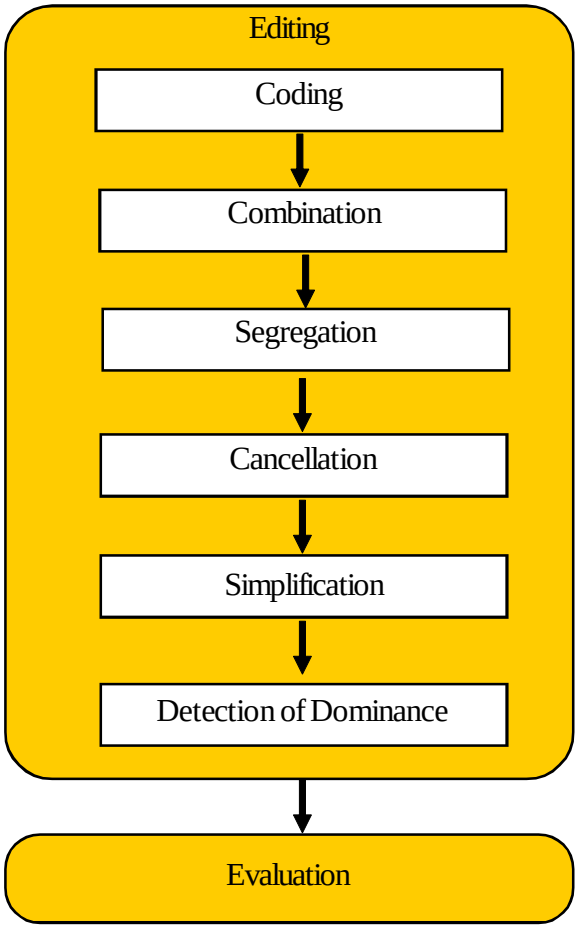
The probability weighting function for losses is described by:

$$w^{-}(p) = \frac{p^{\delta}}{(p^{\delta} + (1-p)^{\delta})^{\frac{1}{\delta}}}$$

with $\gamma = 0.61$ and $\delta = 0.69$. The robustness of prospect theory has been assessed in several empirical studies. For example, in a majority of the studies surveyed by Camerer (1994, 1995), Edwards (1996), and Starmer (2000), prospect theory correctly explains experimentally observed results.

Prospect theory introduces two qualitatively different decision making and information processing phases: *editing* and *evaluation*. *Editing* is the preliminary analysis of prospects under consideration in which four major sequential operations occur: coding, combination, segregation, and cancellation (Fig. 1). In *coding*, decision makers set a reference point by which all gains and/or losses are measured. In *combination*, prospects with identical outcomes are reduced to one prospect. In other words, it consists of the aggregation of probabilities associated with identical outcomes.During *segregation* the certainty component is segregated from the risk component (i.e., (300, 0.8; 200, 0.2) is segregated into a sure gain of 200 and the risky prospect (100, 0.8).C*ancellation* involves discarding the components of choices that are common to all prospects. During *simplification*, prospects may be simplified to assess their value more easily (i.e. a chance of (101, 0.49) is probably recoded as an even chance to win 100. The final operation in the editing phase is *dominance detection*, in which dominated alternatives are removed from further consideration.In the second phase, *evaluation*, the edited prospects are assessed to find the one with the highest value, defined as a function of two arguments: the asset position (which serves as a reference point) and the magnitude of change. The decision-maker then chooses the prospect with the highest value.This decision model highlights the psychological aspects of decision making under risk and uncertainty.

Prospect theory addresses both the decision process and the factors that influence decisions including values, emotions and experiences. Prospect theory's decision making process (Table 1) starts with defining the problem and continues with generating alternative solutions for the environmental hazards and disaster planning problem in the second stage. Unlike the rational model, prospect theory argues that what we generate at this stage are not solutions, but rather prospects (due to the inherent risk and uncertainty in decision making processes). The third stage of the prospect theory approach to decision making is editing. Here, a combination of technical and cognitive tools helps decision makers to analyze (edit) different decision prospects (scenarios). At this stage, communication factors and human cognitive judgments and values play major roles.




Source: Burnes *et al.*, 2005

**Fig. 1. The decision making process according to prospect theory**

**Implications of Prospect Theory in Environmental Hazards and disaster planning**

As mentioned previously, prospect theory explains why and how individuals make decisions under risk and uncertainty situations and show how because of certain psychological effects individuals could end up irrational decisions, if we consider rational model as the norm. These effects are: certainty effects; framing effects; reference point effect; loss aversion effect; and availability effect. This section reviews some of the potential implications of these psychological effects in hazards and disaster planning as illustrated by prospect theory. For each effect first the effect is explained and then an example of the effect in environmental hazards and disaster planning is provided and discussions are made on potential implications of each effect for environmental hazards and disaster planning.

**Table 1. Decision making models in rational hazards and disaster planning and prospect theory**

| Rational Theory | Prospect Theory |
|---|---|
| Define Problem | Define Problem |
| Generate Solutions | Generate Prospects |
| Analyze Solutions | **Editing Prospects**<br>• Coding<br>• Combination<br>• Segregation<br>• Cancellation<br>• Simplification<br>• Detection of Dominance |
| Evaluate Alternatives | Evaluation |
| Select Alternative<br>Implement | Select Alternative<br>Implement |

## Certainty Effect

One of the most important explanations of irrationality in individual's behavior when making decisions under risk and uncertainty conditions is called certainty effect by prospect theory. Certainty effect highlights the human tendency and preference for certainty in gain domains. Certainty effect is the difference between eliminating uncertainty and only reducing it (Kahneman and Tversky, 1979). In other words, decision makers tend to underweight decision outcomes that are merely probable in comparison with outcomes that are obtained with certainty. This tendency contributes to risk aversion in choices involving sure gains and to risk seeking in choices involving sure losses. For example experiments show that in a choice between receiving $ 4000 with probability 0.8 and $ 3000 with certainty more people (80%) will choose to take the second option. This effect is an important contributing factor for a considerable number of less risky choices even though they seem economically irrational.

The certainty effect can have important implications for environmental hazards and disaster planning because environmental hazards and disaster planning actors are also making their choices under risk and uncertainty conditions and they also might make irrational decisions by preferring less risky choices even though if the overall probable gain from risky choices will be more. Therefore, it can be argued that hazards and disaster planning actors might prefer less risky hazards and disaster planning alternatives when considering positive gains of different alternatives. For example, it can be hypothesized that when planners face between the following options: if policy A is undertaken 4000 new jobs will be created with probability of %80; if policy B is undertaken 3000 jobs will be created for sure; most of them tend to choose policy B using the same arguments.

What are the implications of this effect for environmental hazards and disaster planning? Are the key players in environmental hazards and disaster planning actors subject to certainty effect? Does it matter if planners become subject to this effect? What are the overall consequences of this effect on environmental hazards and disaster planning and decisions? Is there anything planners can do to reduce the certainty effect? In decisions where physical risks are involved the certainty effect means that people prefer the total elimination of risk instead of reducing it.For example, consider a case when planners need to make a choice between two projects, they will prefer the one that has no environmental risk or eliminate the risk as compared to the project that reduces the risk even more than the other project. In other words people prefer to reduce chances of something bad happening from something to nothing than by the same amount but not to zero. Stakeholders involved in the environmental hazards and disaster planning process might be subject to this effect when choosing scenarios or outcomes in which certain gains or benefits are compared with larger gains but with some levels of uncertainty. Planners should expect people to prefer certain hazards and disaster planning outcomes as compared to uncertain outcomes even if the total probability value for uncertain outcomes seems more. The fact that individuals decision is against the rational model assumptions might not be necessarily a bad thing.

## Framing Effect

The second effect in prospect theory is called framing effect. The concept of "framing" can be interpreted very broadly. At a very basic level it simply refers to the process through which individuals or groups perceive and make sense of their external environment. In other words, frames are cognitive devices that help make sense of complex information and believed to precede conscious processing of information for decision making and to affect subsequent individual choices (Sheppard *et al.*, 1994; 55). At a more complex level framing is a form of manipulating the salience or accessibility of different aspects of information.

In prospect theory framing is defined as the decision-maker's conception of the acts, outcomes, and contingencies associated with a particular choice (Teversky and Kahneman, 1981). Framing relates to three specific elements of a choice: the actor's perception of the alternative courses of action; the outcomes associated with those alternatives; and the probabilities associated with particular outcomes. The framing of acts assumes that individuals are not simply concerned with the accomplishment of goals, but are also attentive in selecting the means that lead to goal achievement. "Prospect theory, with its emphasis on the importance of the framing in decision making, has proven successful in explaining decision behavior that does not fit earlier models such as rational models.

Framing effects constitute one of the most stunning and influential demonstrations of irrationality (Tversky and Kahneman 1987). A framing effect occurs when different, but logically equivalent, words or phrases cause individuals to alter their preferences. For example, people reject a policy program when told that it will result in 5% noise pollution but prefer it when told that it will result in keeping the environmental quality at 95%. Framing effects violate a basic tenet of rational choice theory that individuals' preferences do not change from alternative ways of eliciting the same preference (e.g., preferences should not depend on whether the programs are described in terms of air pollution or air quality.

People appear to exhibit a general tendency to be risk seeking when confronted with negatively framed problems and risk averse when presented with positively framed problems (Gondzales *et al*., 2005). In the past 30 years, hundreds of empirical studies have been conducted to show and examine the framing effect in many different contexts (Kuhberger, 1998). Building on these experiments, many social scientists opt for models of decision-making that incorporate framing effects and reject rationality assumptions. Examples within political science include studies of voting and public opinion, campaigns, policy-making, foreign-policy decision-making, coalition bargaining, judicial decision-making, and a variety of other topics (see Levy 2003). Framing effects also call into question normative models of democratic governance based on the idea that citizens maintain stable and invariant preferences (Bartels 2003).

In environmental hazards and disaster planning, frames can be made differently and much wider than what is discussed by the prospect theory and could have significant implications for hazards and disaster planning and planners.It can be argued that hazards and disaster planning actors could be subjects to framing effect.During the hazards and disaster planning process, framing might be used as a tool by some stakeholders to achieve their interests. Planners can play a major role in this process through reframing. Framing can also encourage or discourage public participation in environmental hazards and disaster planning. Some of these implications are discussed here.

Just like any decision problem, it is possible to frame a given environmental hazards and disaster planning problem or scenario in more than one way by using different writing, verbal and visual techniques. An interesting study to refer to is the one that conducted by Shah et al. (2004). They examined the effects of two different frames concerning urban growth using a sample of 379 citizens in Madison, USA.Through a series of questions about the rate of growth in vehicular traffic and employment, respondents were asked to indicate if they felt current rate of growth should increase, decrease, or stay the same after hearing a radio story about urban growth in their region. To test effect of framing they developed a 2x3 experimental design using a simulated professionally produced radio news report as the manipulation and respondents were randomly assigned to one of the six conditions. The reports framed urban growth in terms of losses or gains and presented the issue at an individual, mixed, or societal level. In the negative frame (loss condition), the broadcast contrasted the negative consequences of uncontrolled growth with negative consequences of restricting growth. In the positive frame (gain condition), it contrasted the positive consequences of controlled growth and positive consequences of unrestricted growth. Respondents receiving the societal condition heard about growth in terms of its effect (loss or gain) on the community without mention of individuals. Those receiving the individual condition heard people describe the effects of growth on their families. In the mixed condition, respondents heard about how growth would affect both individuals and the community. Across all conditions, the factual information remained the same and the

language remained as constant as possible. They concluded that individuals support for urban growth varies significantly depending on how the problem has been framed.

Framing is also an important issue in hazards and disaster planning negotiations especially when different stakeholders participate in some forms of negotiation. In such situations players have an incentive to attempt to influence others' evaluation of the relative costs and benefits of certain environmental hazards and disaster planning options or policies (Levy, 2000).Some players, under some conditions, can manipulate other actors into a decision or policy choice that is more desirable to them. This can be done by changing the risk attitude of other actors so that they select a different policy or option. The argument revolves around the simple idea that during the negotiations process actors establish both the substance of the issue and the domain in which the negotiation occurs. When one actor is satisfied with the status quo and the second actor is not, the second actor can manipulate the beliefs of the first actor using different framing techniques.Usually, parties in an environmental hazards and disaster planning negotiation develop different frames about what is at stake and what should be done and by whom. Gray (1997), for example, has addressed several basic frames, identified through content analysis of communication exchanges: loss-gain; characterization; process; outcome; and aspiration frames. Using an expanded version of these frames Kaufman and Smith (1999) investigated framing and reframing processes in land-use changes.

Planners can play a role in this process through reframing. Reframing consists of a deliberate attempt to alter someone else's frame. Reframing occurs during negotiations (Putnam & Holmer, 1992), usually to facilitate communication, but also to promote the reframe's preferred outcome. It can shape the course of joint decision making. At times it may be detrimental to some interests, especially when opportunities are lost with unforeseen, long-term or irreversible consequences. On the other hand, planners can use reframing to foster agreements when they cannot alter either the resource distribution or the conflicting parties' behavior (Kaufman & Duncan, 1988). Therefore, planners may find themselves having to rely on these devices when they intervene in hazards and disaster planning related negotiations or conflicts (Susskind and Ozawa, 1984; Dotson *et al.,* 1989).

However, reframing poses some particularly difficult political and ethical dilemmas and questions for planners. Is there a range of reframing activities sufficiently consistent with current practice, mandate interpretation, and ethical norms to garner consensus among planners and architects working in public agencies? Answers to this question hinge on the on-going debate surrounding planners' roles, and even the standards for ethical behavior (Howe, 1994).

Another implication of framing in environmental hazards and disaster planning speak about the fact that framing can be used as a manipulation tool and thus works as a distortion source for effective communication action (Ordeshook, 1986; Riker, 1986).Manipulation usually focuses on the frame of the hazards and disaster planning or decision structure and how this influences the hazards and disaster planning process and for this to occur, some critical conditions must be evident. There are several ways that a decision maker can be manipulated by framing. First, the degree of description can affect the acceptability of options.Second, changing the description of frames, even when using the same options and degree of description, can result in different selections. These conditions include asymmetrical or uncertain information about the preferences and context of the environmental hazards and disaster planning problem (Maoz, 1990).If hazards and disaster planning actors do not effectively communicate and convey information about their preferences to the other actor in the hazards and disaster planning process it will distort the communication and will create inefficiency in decisions (Camerer and Knez, 1997).

The third implication of framing in environmental hazards and disaster planning relates to the impacts of emotions and feelings on frame and framing and thus on decision making and hazards and disaster planning. Emotions and feelings are not merely consequences of a frame but can be sources of framing. Farnham (1997) demonstrates that people's feelings can cause them to reframe their choices which, in turn, can cause them to reverse their preferences. Welch (1993) finds additional evidence that feelings influence how people frame their prospects. For example, he argues that feelings of injustice, defined as a perceived discrepancy between

entitlements and benefits, explain why people and policy makers take big risks for marginal gains. A perception of injustice "engages powerful passions that have the effect of increasing the stridency of demands, amplifying intransigence, reducing sensitivity to threats and value tradeoffs, increasing the willingness to run risks, and increasing the likelihood of irrational behavior" (Welch 1993; 20).

The fourth implication deals with the impacts of framing on public participation. Framing can foster public participation in hazards and disaster planning or lead community members to suspect that participation is unnecessary or even futile. For example, whenever decisions made by politicians or bureaucrats allow for public input, cynical framing of public officials (i.e., they don't care about what citizens have to say) can discourage participation, as can framing that suggests only experts are able to understand the issues. Framing that means decisions are in the hands of certain groups might encourage people to shape strong political allies in order to prevail. On the other hand some frames might carry a shared, or collective, meaning that can stimulate people's engagement. As an example consider the "not in my back yard (NIMBY)" label that is associated with the sitting of high-risk land uses such as nuclear plants and hazardous waste facilities, has attained frame status. It is now widely used o any unwanted land use, including shopping malls and even parks. When such frame is attached to an environmental hazards and disaster planning proposal it can trigger individual and community-wide opposition (Kaufman and Smith, 1999).

The fifth implication of framing effects in environmental hazards and disaster planning is concerned with the relationship between frames and actions. Frames derived from collective past experience can encourage or discourage actions. For example, residents in a poor neighborhood might be opposed to replacing a closed factory with a minimum security prison, but may feel hopeless about preventing this change because little attention has been given to neighborhood concerns in the past. The frame held by these residents' leads to inaction, based on failed or discounted previous efforts, so they tend to let things happen. In comparison, residents in a middle class suburb who have successfully used resources to block unwanted land uses in the past, might hold a frame encouraging action, which leads them to challenge obstacles. The consequence of the frame difference in the two neighborhoods is found in the level of readiness for collective action. The inaction frame will likely lead to missed opportunities to participate in, and affect, hazards and disaster planning decisions while the action frame might push residents to fight any development, possibly regardless of its merits (Kaufman and Smith, 1999). The last implication speaks about the impacts of frames on information processing. In this context frames are not just equivalent to a professional outlook or set of alternatives, but, frames result from and leads to information processing shortcuts (Schön & Rein, 1994). For example, a planner with an equity mind frame might oppose investment in a specific project that does not provide choices for those who have few (Krumholz and Clavel, 1994; 1), while an economic development planner might favor such investment by framing it in a way that he expect this project will benefit the whole community in the long run. Both planners' reliance on frames can obscure situational details that might lead each to a different choice in a specific situation.

In conclusion to this section it should be noted that frames of any type filter the information necessary for decision making, reducing the match between decisions and the situation to which they pertain. In general, the effect of frames and framing on the quality of outcomes for different players' need to be recognized. Planners must understand which kinds of information are useful for counteracting frames detrimental to the hazards and disaster planning process (in the sense of filtering situation specifics), and for promoting frames that encourage participation and joint decisions. Planners need to ponder their roles and the ethical dilemmas they face. They should be able to recognize different frames. A challenge for hazards and disaster planning theory and practice is to devise tools to accurately recognize frames at work in specific situations. As discussed by Kaufman and Smith (1999) there are several obstacles including lack of access to all key players; tracking frame changes during the hazards and disaster planning process; relying on self-reporting or second-hand data; and, case specifics that defy generalization.

**Reference Point Effect**

The third effect discussed and used in prospect theory is called the reference point effect. The

reference point divides the space of decision outcomes into regions of gains and losses, or success and failure. According to the prospect theory, the variation of the reference point determines whether a given outcome is considered a loss or a gain. Decision makers evaluate decision outcomes either as gains or losses relative to a neutral reference point and as results their choice become dependent on the selected reference point. In most cases, however, decision makers' reference points are the status quo and they tend to anchor to that. Empirical evidence shows that individuals are reluctant to move away from the status quo even though there may be substantial gains to them in doing so. It is due to the fact that people solve problems by starting from an initial guess or salient starting point that is then adjusted to generate final decisions, but such adjustments are often insufficient and lead the final choice toward the often arbitrary reference point (Laibson and Zeckkauser, 1998).

Does reference point effect exist in environmental hazards and disaster planning? What are the potential reference points in environmental hazards and disaster planning and what do they represent? What factors influence environmental hazards and disaster planning related reference points? These are typical questions one need to answer when assessing the implications of reference point for environmental hazards and disaster planning.

Reference point effect exists in environmental hazards and disaster planning. In the spirit of prospect theory, it can be assumed that hazards and disaster planning outcomes are evaluated by each actor with respect to a reference point. For each hazards and disaster planning actor, the same hazards and disaster planning outcome could have different utilities depending on the reference point used to evaluate the outcome. Assume an outcome *x* was obtained. If the player was expecting an outcome *y* which is preferred to *x*, she would be less happy with *x* than if she had been expecting an outcome *z* which is less preferred than *x*. For example, a property tax rebate of $500 gives different utility depending on whether $1000 was expected, or the $500 came as a surprise. It is difficult to say how the reference level can be measured, as it is highly situation dependent. People do not see hazards and disaster planning outcomes as neutral, but categorize them as a success or failure and then they experience positive or negative emotion based on their categorization.The reference point (of the value function) plays a key role in this categorization because it divides the space of hazards and disaster planning outcomes into a positive and negative region.

There are many sources for reference points in environmental hazards and disaster planning and because of the role that the reference points could play in environmental hazards and disaster planning, it is important to specify what these points are for hazards and disaster planning actors. In hazards and disaster planning reference point could be different things: current state of the community (status quo), hazards and disaster planning goals, future state of the community, and previous state of the community, another community or region. Planners can use hazards and disaster planning incentives, local conditions, politics, and local governments' institutional structures to help identify what actors are likely to view as a reference point. All players in the environmental hazards and disaster planning process have their own reference points and make their decisions around them. Generally reference points are representing expectations based on the past experiences, norms of fairness and social customs (Shalev, 2002) and as such peoples and planners' expectations are shaped by past experiences, comparisons between communities, environmental hazards and disaster planning norms, and the future as well.

Reference points are sometimes states to which people and planners have adopted: it is sometimes set by social norms and expectations; it sometimes corresponds to a level of aspiration, which may or may not be realistic (Tversky and Kahneman, 1981; 456). As mentioned before, one special case of reference point is the status quo (Samuelson and Zeckhauser, 1988), which describes the tendency of individuals to choose the "default" option or leave a situation unchanged, even if other alternatives are chosen when there is no pre-existing status quo. Status quo serves as an important reference point for planners and hazards and disaster planning actors. Planners and hazards and disaster planning organizations sometimes face choices not between narrowly defined alternatives, but between the status quo and some change (Kanner, 2004; 218). Environmental hazards and disaster planning actors can use the status quo as a reference point for

determining their domain. When actors satisfied with the status quo, they tend to be in a domain of gain; when they are dissatisfied, they tend to be in a domain of loss. In many cases, assessing a hazards and disaster planning actor's domain is simple: Is the status quo acceptable or not? When actors find their position deteriorating, they are likely to view themselves in a domain of loss. It is important to notice, however, that dissatisfaction with the status quo may also result from a hazards and disaster planning actor being in the domain of gain.

Environmental hazards and disaster planning goals can also serve as reference points in hazards and disaster planning. Most plans start with goals that provide motivations for communities. Planners and communities will strive harder and more diligently when they face specific and challenging hazards and disaster planning goals, such as reducing the urban growth or creating a more sustainable community. Hazards and disaster planning actors should feel worse when they fail to reach their goals. As such hazards and disaster planning goals can serve as reference points and could systematically alter the value of outcomes as described by prospect theory (Kahneman & Tversky, 1979). Principles of the value function in prospect theory are sufficient to explain how hazards and disaster planning goals might affect communities' motivation.The following hypothetical example demonstrates this principle.

Assume that city *x* has had followed revenue plans that has generated 20 million dollars additional revenue each year to invest in mitigation strategies that reduce the risk of natural disasters. Last year, the city set a goal of generating 25 million dollars. Through significant efforts, city officials generated 30 million dollars and stopped before the end of the fiscal year. This year the city set a goal of generating 35 million dollars, but the city could generate only 30 million dollars by end of the fiscal year, even after much effort. What emotion will the community experience? Which year they should be happier about their performance? Although the overall results are the same in both years, it is expected that the community have possibly experienced positive emotions last year and negative emotions this year. Experimental studies on similar topics support these expectations (Heath *et al.*, 1999). This example demonstrates that goals, like reference points, divide outcomes into regions of good and bad, success and failure. If goals are reference points, then people who set goals will sometimes feel worse about their performance even when they perform better.

Another implication of the reference point in hazards and disaster planning is its impact on public participation. Individuals or groups who feel that hazards and disaster planning policies or proposals have led to outcomes exceeding their reference level are less motivated to participate in the hazards and disaster planning sessions than those who view the current hazards and disaster planning policies or proposals as being responsible for outcomes falling below their reference level.

Further work should be conducted on how best to define the reference point in environmental hazards and disaster planning, and how to separate the reference point as status quo from the reference point defined in terms of level of expectation, aspiration, hazards and disaster planning goals, and social comparison. This is not technically a limitation because work has been able to progress under the assumption that the status quo served as the default value for the reference point in environmental hazards and disaster planning. And the theory does specifically delineate those factors, such as hazards and disaster planning goals, expectation levels, which can alter the reference point away from the status quo. However, this aspect of prospect theory could benefit from some greater specification about when and how the reference point is influenced by factors beyond the status quo point itself.

**Loss Aversion Effect**

Perhaps one of the most important implications of prospect theory is loss aversion. The principle of loss aversion states that losses are experienced more intensely than gains of similar objective magnitude or that losses will be more painful than gains will be pleasurable (Kahneman & Tversky, 1979; Tversky, 1994; Tversky & Kahneman, 1991, 1992). Experimental work in both the psychological and the economic literature suggest that people are motivated to minimize loss more than they are motivated to maximize gain (see for example De Dreu *et al.*, 1994, 1995; Kramer, 1989; Taylor, 1991). Loss aversion has also been termed as one of the basic principles in decision making (Hastie, 2001), and has been suggested to underlie many well studied effects in decision making (Kahneman, Knetsch, & Thaler, 1986,

1990; Thaler, 1980; Knetsch, 1989; Knetsch & Sinden, 1984; Ritov & Baron, 1992; Samuelson & Zeckhauser, 1988; Schweitzer, 1994).

As an example of the loss aversion effect, consider the results of experiments showing that a price increase is judged as more unfair than a cancellation of a former price reduction and a cut in wages is perceived as more unfair than a cancellation of a wage raise, even when both moves are objectively similar. According to the loss aversion effect, a price increase or wage cut are perceived as losses, whereas a cancellation of a price reduction or a bonus are perceived as non gains.

This effect has a number of implications in environmental hazards and disaster planning because hazards and disaster planning actors might show similar behavior with regard to different hazards and disaster planning policies and changes.The implications of loss aversion in hazards and disaster planning comes from the fact those most hazards and disaster planning scenarios, policies and actions (and their changes) have potential gains for some people and potential losses for others. Again this effect might explain why those who are negatively affected by hazards and disaster planning policies or projects are more concerned as compared to those who are positively impacted with the same policies or projects.

Another implication of this effect for hazards and disaster planning theory and practice refers to the fact that giving up something people possess makes them feel differently than not getting something they want. For example, it will be harder to discontinue a risk reduction activity once it has been provided than not providing a hazard mitigation service from the beginning.Because of the loss aversion effect loses are experienced more acutely than gains.Environmental hazards and disaster planning practice is full of promises made by politicians and even planners.According to prospect theory, promises should be most effective for hazards and disaster planning actors who seek to avoid losses and least effective for hazards and disaster planning actors who seek gains from a hazards and disaster planning proposal (Davis 2000, p. 37).Loss aversion also plays an important role in hazards and disaster planning negotiation and bargaining. Loss aversion is now a major extension of Nash's (1950) classical bargaining model. Studies show that participants in a negotiation and bargaining process are more likely to reach an agreement when the outcomes are framed as gains than when they are framed as losses due to the loss aversion effect.This is because people try to avoid losses and do not accept hazards and disaster planning options that are framed around losses (Bazerman *et al.*, 1985; Neale and Bazerman, 1985).

Loss aversion has also some important implications for community development and change. If hazards and disaster planning actors are risk averse in the gain domain and risk seeking in the loss domain, they will work to maintain what exists but will take fewer chances to bring about a better situation. As long as existing hazard mitigation arrangements are satisfactory, people are not prone to break them in order to make gains. This can limit progress as communities maintain suboptimal disaster risk reduction rather than seek an improved outcome (but this also inhibits people from embracing risky activities). Therefore, loss aversion not only may render some situations particularly dangerous, but also may indicate that some policies that would otherwise be attractive should in fact be avoided because they will inflict more pain than standard analysis would imply. For example, local hazard mitigation policies that produce impressive average growth over time but involve cycles of gains and losses may produce less local happiness than policies that produce slower but steadier increases in wealth (Jervis, 2004).

Therefore, there are two main implications of loss aversion for hazards and disaster planning: 1) planners should be aware of loss aversion in their own hazards planning and decision making; and 2) planners should anticipate loss aversion in the actions of other hazards and disaster planning actors. The first is harder to implement than the second. Loss aversion partly a psychological effect and it is very important for decision makers in hazards and disaster planning not only to know which suboptimal decisions they made, but also to know how they can improve hazards planning decision making. Awareness of biases is not always sufficient to change action or behavior. However, knowing how other hazards and disaster planning actor's judge and reason may help in designing better environmental hazards and disaster planning policies, measures and proposals.

**Availability Effect**

The final effect that is reviewed is the availability effect. Availability derives from the

hypothesis that people assess the probability of an event by the rate or ease with which instances or occurrences can be brought to mind.In psychological terms cognitive psychology suggests that, compared to unfamiliar information, familiar information is more easily accessible from memory and thus is believed to be more real or relevant. The result of this effect is that disproportionately high weight is assigned to salient or easily remembered information (Tversky and Kahneman, 1973). Familiarity and availability may thus serve as *cues* for accuracy and relevance. Hence, people will overstate the probability of a deadly tornado in a city if they personally know someone who has been injured in a tornado, even if they have access to more relevant aggregate statistics. Repetition of certain news and events in the media, regardless of their accuracy, makes it more easily available and therefore falsely perceived as more accurate. Such evidence on human judgment demonstrates that people's reasoning violates basic laws of rationality in a systematic way. By demonstrating this, prospect theory has seriously questioned the empirical validity of one of the fundamentals of traditional rational decision making theory.

This availability effect has been shown to be an important factor influencing many natural hazards plans and projects, especially those with potentially significant socio-economic and environmental impacts. The decisions of planners faced with disaster risk management decisions are often affected by the availability effect. Where there has been recent negative events with significant media coverage (such as an explosion in a chemical factory), precaution is high for certain types of hazards and disaster planning proposals even though the actual physical conditions or risk might have not changed significantly.The availability effect will also impact the forecasts of planners and decision makers. Recent events will be given higher probability of recurrence. The recent attention of urban planners and emergency management decision makers to certain types of risks, such as the risk of terrorism, are all due to the availability impact created after September 11, 2001. However some researchers argue that this effect will diminish in the long run because (i) people, through repetition, will learn their way out of availability effect (ii) experts in a field, such as planners, will make fewer errors; and (iii) with more powerful incentives, the effects will disappear as people obtain more real-world experience.

## CONCLUSION

Although there is not much literature on the applications of prospect theory in hazards and disaster planning, it is not difficult to establish conceptual and practical linkages between the two. Prospect theory provides its unique decision making model that is different from previous models as it addresses both the risk reduction decision process and the factors that shape and influence disaster decision making, including values, emotions and experiences. Prospect theory also has the potential to be expanded for group and organizational risk and hazards decision making. Moreover, uncertainties are inherent in hazards and disaster planning. All planners and decision makers involved in the hazards and disaster decision making process, in one way or another, directly or indirectly, face a number of behavioral, social, economical, political and environmental uncertainties. Prospect theory, as an alternative theory of decision making under uncertainty explains how individuals make decisions under conditions of risk and uncertainty conditions, by emphasizing the role for psychological factors.It is now widely accepted that communication and interaction between stakeholders and planners are inherent characteristics of hazards and disaster planning practice. In this context, a planners' role is to communicate knowledge between different groups in the hazards and disaster planning process by defining the hazards and disaster planning problem, by creating an interactive relationship between experts and the stakeholders in the communities they serve and by integrating facts, values, and interests in the decision making process.

Hence, we conclude that all stakeholders in the hazards and disaster planning process are subject to certainty, framing, reference point, loss aversion, and availability effects. Prospect theory acknowledges that hazards and disaster planning decisions are formulated on the basis of judgment and values, in addition to technical criteria, and that such decisions vary between different players and under uncertainty situations. Prospect theory extends the role of values, emotions, and perceptions in decision making. Prospect theory's explicit focus on values may be its most important

contribution to hazards planning and disaster decision analysis. In conclusion, we have shown that prospect theory sheds light on several important issues related to hazards and disaster planning theory and practice and that prospect theory has the potential to transform existing hazards and disaster planning theory. More studies should be carried out in order to further explore some of the implications discussed in this article.

## REFERENCES


Allmendinger, P. (2002). Hazards and disaster planning Theory. Basingstoke, Palgrave.

Barberis, N., Huang, M. and Santos, T. (2001). Prospect Theory and Asset Prices. *Quarterly Journal of Economics*, **116**, 1-53.

Bartels, L. M. (2003). Democracy with Attitudes. In: Michael Bruce MacKuen, and George Rabinowitz (eds.), Electoral Democracy.Ann Arbor: The University of Michigan Press.

Baucells, M. H. (2004). Reevaluation of the results of Levy and Levy. *Organizational Behavior and Human Decision Processes*, **94**, 15–21.

Bazerman, M. H., Magliozzi, T. and Neale, M. A. (1985). Integrative Bargaining in a Competitive Market. *Organizational Behavior and Human Decision Processes*, **35**, 294-313.

Beauregard, R. (1989). Between Modernity and Post-Modernity: The Ambiguous Position of U.S. Hazards and disaster planning. *Environment and Hazards and disaster planning, D. Society and Space*, **7,** 381-395.

Burns, C., Asgary, A. and Levy, J. (2005). Operator Support for Ageing Nuclear Critical Infrastructure Systems: Integrating Ecological Interface Design with Prospect Theory. *International Journal of Critical Infrastructures*, **4(1),** 299-311.

Camerer, C. (1995). Individual decision making. In: J. Kagel & A. Roth (Eds.), Handbook of experimental economics (pp. 617–703). Princeton, NJ: Princeton University Press.

Camerer, C. and Ho, T. (1994). Violations of the between axiom and nonlinearity in probability. *Journal of Risk and Uncertainty*, **8,** 167–196.

Camerer, C. and Knez, M. (1997). Coordination in Organizations: A Game-Theoretic Perspective. In: Z. Shapira (ed.), *Organizational Decision Making* (New York: Cambridge University Press).

Davis, J. W. (2000). Threats and Promises: The Pursuit of International Influence. Baltimore, MD, Johns Hopkins Univ. Press.

De Dreu, C. K. W., Carnevale, P. J. D., Emans, B. J. M. and van de Vliert, E. (1994). Gain-loss Fames in Negotiation: Loss Aversion, Mismatching, and Frame Adoption. *Organizational Behavior and Human Decision Process*, **60**, 90–107.

De Dreu, C. K. W., Carnevale, P. J. D., Emans, B. J. M. and van de Vliert, E. (1995). Outcomes Frames in Bilateral Negotiation: Resistance to Concession Making and Frame Adoption. In *European Review of Social Psychology*, ed. W. Stroebe and M. Hewstone, 97–125, New York: Wiley.

Dotson, A. B., Godschalk, D. and Kaufman, J. (1989). The Planner as Dispute Resolver: Concepts and Teaching Materials. National Institute for Dispute Resolution.

Edwards, K. D. (1996). Prospect theory: A literature review., *International Review of Financial Analysis*, **5,** 18–38.

Faludi, A. (1973). Hazards and disaster planning Theory. Oxford, Pergamon.

Faludi, A. (1986). Critical Rationalism and Hazards and disaster planning Methodology. London, Pion.

Faludi, A. (1987). A Decision-centred View of Environmental Hazards and disaster planning. Oxford, Pergamon.

Faludi, A. (1989). Conformance vs. performance: implications for evaluations. Impact Assessment Bulletin, **7,** 135-151.

Faludi, A. (1996). Rationality, Critical Rationalism and Hazards and disaster planning Doctrine. In: S. J. Mandelbaum, L. Mazza & R. W. Burchell (Eds) Explorations in Hazards and disaster planning Theory. New Jersey: Center for Urban Policy Research, Rutgers University.

Faludi, A. and Mastop, J. M. (1982). The 'IOR School': the Development of a Hazards and disaster planning Methodology" *Environment and Hazards and disaster planning B: Hazards and disaster planning and Design*, **9,** 241-256.

Faludi, A. and Vander Valk A. J. (1994). Rule and Order: Dutch Hazards and disaster planning Doctrine in the Twentieth Century. Dordrecht, Kluwer Academic Publishers.

Farnham, B. (1997). Roosevelt and the Munich Crisis: A Study of Political Decision-Making. Princeton, New Jersey, Princeton Univ. Press.

Forester, J. (1980). Critical theory and hazards and disaster planning practice. *Journal of the American Hazards and disaster planning Association*, **46,** 275-285.

Forester, J. (1989). Hazards and disaster planning in the Face of Power. Berkeley, University of California Press.

Forester, J. (1993). Critical Theory, Public Policy, and Hazards and disaster planning Practice: Toward a Critical Pragmatism. New York, State University of New York Press.

Forester, J. (1996). Argument, power, and passion in hazards and disaster planning practice. In: S. J. Mandelbaum, L. Mazza & R. W. Burchell (Eds) Explorations in Hazards and disaster planning Theory. New Jersey, Center for Urban Policy Research, Rutgers University.

Friedmann, J. (1987). Hazards and disaster planning in Public Domain: from Knowledge to Action. Princeton, Princeton University Press.

Gonzalez, C., Dana, J., Koshino, H. and Just, M. (2005). The Framing Effect and Risky Decisions: Examining Cognitive Functions with fMRI. *Journal of Economic Psychology,* **26,** 1–20.

Goodall, B. (1987). Dictionary of Human Geography. Harmondsworth: Penguin Books.

Gray, B. (1997). Framing and Reframing of Intractable Environmental Disputes. In: Lewicki, R., R. Bies, and B. Sheppard (Eds.), *Research on Negotiation in Organizations*, 6,171.

Hastie, R. (2001). Problems for Judgment and Decision Making. *Annual Review of Psychology,* **52,** 653-683.

Healey, P. (1993). The communicative work of development plans. *Environment and Hazards and disaster planning B: Hazards and disaster planning and Design,* **20,** 83-104.

Healey, P. (1997). Collaborative, Hazards and disaster planning: Shaping Places in Fragmented Societies. Basingstoke, Macmillan.

Heath, C., Larrick, R. P. and Wu, G. (1999). Goals as Reference Points. *Cognitive Psychology,* **38,** 79–109.

Howe, E. (1994). Acting on Ethics in City Hazards and disaster planning. New Brunswick, NJ: Center for Urban Policy and Research. Rutgers, The State University.

Huxley, M. (2000). The limits to communicative hazards and disaster planning. *Journal of Hazards and disaster planning Education and Research,* **19,** 369-377.

Innes, J. (1995). Hazards and disaster planning Theory's Emerging Paradigm: Communicative Action and Interactive Practice. *Journal of Hazards and disaster planning Education and Research,* **14**(3), 183-189.

Jervis, R. (2004). The Implications of Prospect Theory for Human Nature and Values. *Political Psychology*, **25(2),** 163-176.

Jolls, C., Cass, S. and Thaler, R. H. (1998). A Behavioral Approach to Law and Economics. *Stanford Law Review,* **50**, 1471-1550.

Kahneman, D. and Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica,* **47(2),** 263–291.

Kahneman, D. and Tversky, A. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *J. of Risk and Uncertainty,* **5,** 297-324.

Kahneman, D. and Tversky, A. (2000). Choices, Values, and Frames. In: *Choices, Values, and Frames*, ed. By D. Kahneman, and A. Tversky. New York, Russell Sage Foundation.

Kahneman, D., Knetsch, J. L. and Thaler, R. (1990). Experimental tests of the endowment effect and the Coase theorem. *Journal of Political Economy,* **98,** 1325–1348.

Kanner, M. D. (1999). Framing and the Role of the Second Actor: An Application of Prospect Theory to Bargaining. *Political Psychology,* **25(2),** 213-239.

Kaufman, S. and Smith, J. L. (1999). Framing and Reframing in Land Use Change Conflicts. *Journal of Architectural and Hazards and disaster planning Research,* **16,** 164-180.

Kaufman, S. and Duncan, G. T. (1988). The role of mandates in third party intervention. *The Negotiation Journal,* **4(4),** 403-412.

Knetsch, J. L. (1989). The Endowment Effect and Evidence of Nonreversible Indifference Curves. *The American Economic Review,* **79,** 1277-1284.

Knetsch, J. L. and Sinden, J. A. (1984). Willingness to Pay and Compensation Demand: Experimental Evidence of an Unexpected Disparity in Measures of Value. *Quarterly Journal of Economics*, **99,** 507-521.

Kramer, R. M. (1989). Windows of Vulnerability or Cognitive Illusions? Cognitive Processes and the Nuclear Arms Race. *Journal of Experimental Social Psychology,* **25,** 79–100.

Krumholz, N. and Clavel, P. (1994). Reinventing Cities: Equity Planners Tell Their Stories. Philadelphia, Temple.

Kuhberger, A. (1998). A meta-analysis. *Organizational Behavior and Human Decision Processes,* **75**(1), 23–55.

Kundzewicz, Z. W. (1997). Water Resources for Sustainable Development. *Hydrological Sciences Journal*, **42(4),** 467–480.

Laibson, D. and Zeckhauser, R. (1998). Amos Tversky and the Ascent of Behavioral Economics. *Journal of Risk and Uncertainty,* **16,** 4–47.

Levy, J. S. (1987). Declining Power and the Preventive Motivation for War. *World Politics*, **40,** 82–107.

Levy, J. S. (1992). An introduction to prospect theory. *Political Psychology,* **13(2),** 171-186.

Levy, J. S. (1997). Prospect Theory, Rational Choice, and International Relations. *International Studies Quarterly*, **41,** 87–112.

Levy, J. S. (2000). The Implications of Framing and Loss Aversion for International Conflict. In: M. I. Midlarsky (ed.), *Handbook of War Studies II*, University of Michigan Press, Ann Arbor, 193–221.

Levy, J. S. (2001). Explaining Events and Testing Theories: History, Political Science, and the Analysis of International Relations: In C. Elman and M. F. Elman (eds.), *Bridges and Boundaries: Historians, Political Scientists, and the Study of International Relations*, MIT Press, Cambridge, MA, 39–83.

Levy, J. S. (2002). Daniel Kahneman: Judgment, Decision, and Rationality. *Political Science and Politics,* **35,** 271-273.

Levy, J. S. (2003). Applications of Prospect Theory to Political Science. *Synthese*, **135(2),** 215-241.

Lindblom, C. E. (1959). The Science of "Muddling through". *Public Administration Review,* **19(2),** 79-88.

Luce, R. D. and Raiffa, H. (1957). Games and Decisions. Wiley, New York.

Maoz, Z. (1990). Framing the National Interest: The Manipulation of Foreign Policy Decisions in Group Settings. *World Politics,* **43,** 77–110.

March, J. G. and Simon, H. A. (1958). Organizations. New York, Wiley.

McDermott, R. (1998). Risk-Taking in International Politics: Prospect Theory in American Foreign Policy. Ann Arbor, University of Michigan Press.

McDermott, R. (2004). Prospect Theory in Political Science: Gains and Losses from the First Decade. *Political Psychology,* **25,** 289–312.

McNeil, B. J., Pauker, S. G. and Tversky, A. (1988). On the Framing of Medical Decisions. In: David E. Bell, Howard Raiffa, and Amos Tversky (eds.), *Decision Making: Descriptive, Normative, and Prescriptive Interactions*. New York, Cambridge University Press.

Nash, J. F. (1950). The Bargaining Problem. *Econometrica,* **18,** 155-162.

Neale, M. and Bazerman, M. H. (1985). The effects of framing and negotiator overconfidence on bargaining behaviors and outcomes. *Academy of Management Journal,* **28(1),** 34-49.

Ordeshook, P. C. (1986). Game Theory and Political Theory: An Introduction. New York, Cambridge University Press.

Pennington, M. (1996). Conservation and the Countryside: By Quango or Market? IEA Studies on the Environment, No. 6, London, Institute of Economic Affairs.

Putnam, L. and Holmer, M. (1992). Framing, Reframing, and Issue Development. In Putnam, L, Roloff M (Eds.) Communication and Negotiation, (Newbury Park, Sage).

Ramsey, F. P. (1931). Truth and Probability. In: The Foundations of Mathematics and Other Logical Essays. R. B. Braithwaite and F. Plumpton (Eds.) London: K. Paul, Trench, Truber and Co. Reade E, 1987, British Town and Country Hazards and disaster planning. London, Open University Press.

Riker, W. H. (1986). The Art of Political Manipulation. New Haven, Yale University Press.

Ritov, I. and Baron, J. (1992). Status-quo and omission biases. *Journal of Risk and Uncertainty,* **5,** 49-61.

Rosenhead, J. (2001). Robustness analysis: keeping your options open. In: Rosenhead, J. and Mingers, J., 'Rational Analysis for a Problematic World Revisited', Wiley, England.

Samuelson, W. and Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of Risk and Uncertainty,* **1,** 7-59.

Sandercock, L. (1998). Toward Cosmopolis: Hazards and disaster planning for Multicultural Cities. New York, John Wiley.

Savage, L. J. (1954). The Foundations of Statistics. Wiley, New York.

Schön, D. and Martin, R. (1994). Frame Reflection: Toward the Resolution of Intractable Policy Controversies. New York, Basic Books.

Schweitzer, M. (1994). Disentangling status Quo and Omission Effects: An Experimental Analysis. *Organizational Behavior and Human Decision Processes,* **58,** 457-476.

Shah, D. V., Kwak, N., Schmierbach. M. and Zubric, J. (2004). The Interplay of News Fram on Cognitive Complexity. *Human Communication Research,* **30(1),** 102-120.

Shalev, J. (2002). Loss Aversion and Bargaining. *Theory and Decision*, **52,** 201-232.

Sheppard, B. H., Blumenfeld-Jones, K., Minton, J. W. and Hyder, E. (1994). Informal conflict intervention: Advice and dissent. *Employee Responsibilities and Rights Journal,* **7(1),** 53-71.

Siegel, S. (1956). Nonparametric statistics for the behavioral sciences. New York, McGraw-Hill.

Simon, H. A. (1955). A Behavioral Model of Rational Choice. *Quarterly Journal of Economics*, **69,** 99–118.

Starmer, C. (2000). Developments in non-expected utility theory: The hunt for a descriptive theory of choice under risk. *Journal of Economic Literature,* **38,** 332–382.

Susskind, L. and Ozawa, C. (1984). The Planner as Mediator. *Journal of Hazards and disaster planning Education and Research*, **4,** 5-15.

Taylor, S. E. (1991). Asymmetrical Effects of Positive and Negative Events: The Mobilization-Minimization Hypothesis. *Psychological Bulletin,* **110,** 67-85.

Thaler, R. H. (1980). Toward a Positive Theory of Consumer Choice. Journal of Economic Behavior and Organization, **1,** 39-60.

Tversky, A. and Kahneman, D. (1973). Availability: A Heuristic for Judging Frequency and Probability. *Cognitive Psychology,* **5,** 207–232.

Tversky, A. and Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science,* **185(4157),** 1124–1131.

Tversky, A. and Kahneman, D. (1981). The Framing of Decisions and the Rationality of Choice. S*cience* **211,** 453-458.

Tversky, A. and Kahneman, D. (1991). Loss aversion in Risk less Choice: A Reference-Dependent Model. *Quarterly Journal of Economics,* **106,** 1039-1061.

von Neumann, J. and Morgenstern, O. (1944). Theory of Games and Economic Behavior. Princeton, Princeton University Press.

Welch, D. A. (1993). The Politics and Psychology of Restraint: Israeli Decision-Making in the Gulf War. In: J. G. Stein and L. W. Pauly (Eds.), *Choosing to cooperate: How states avoid loss*, 128–169. Baltimore: Johns Hopkins University Press.