BEHAVIORAL - ECONOMIC ANALYSIS OF NEGLIGENCE:
RISK AVERSION AND PERCEPTION OF RISK

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Authorship Declaration

I hereby declare and confirm that this thesis is entirely the result of my own work except where otherwise indicated. I acknowledge the supervision and guidance I have received from Prof. Thomas Eger. This thesis is not used as part of any other examination and has not yet been published.

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1. Introduction.

The thesis examines an alternative, behavioral-economic analysis of the standard of liability based upon Tversky and Kahneman’s Prospect Theory (PT).\(^1\) PT is a decision making theory that proposed a non linear perception of risk, contrary to the rational behavior approach proposed by Utility Theory.\(^2\) The thesis intends to present PT as a substitute for the rationality assumption in the economic analysis of accidents. First, a theoretical argument for the use of subjective attitude towards risk in the measurement of utility is provided. Second, the effects of the new measurement of utility on the liability standard are described by a formal model. The advantages of the proposed standard are further explored by the analysis of study cases, focusing on the Ford Pinto case.\(^3\) Potential critique and implications of the proposed model, as well as its relationship with current legal doctrines, are then discussed.

In 1979 Tversky and Kahneman published their seminal work: “Prospect Theory”, which they later extended and developed.\(^4\) Based on empirical evidence, PT explored individuals' preferences and attitude towards risk. Tversky and Kahneman then published “Cumulative Prospect Theory”,\(^5\) which provided a value and a weighing function for the transformation of objective outcomes and probabilities into perceived ones. The findings of PT were summarized by its authors as: “\textit{risk aversion for gains and risk seeking for losses of high probability; risk seeking for gains and risk aversion for losses of low probability.}”\(^6\)

\(^1\) PT refers to the theory as a hole. See e.g., Kahneman, D., & Tversky A., ‘Prospect Theory: An Analysis of Decision under Risk’, 47 Econometrica, 263 (1979); Tversky, A. & Kahneman D., ‘Advances in Prospect Theory: Cumulative Representation of Uncertainty’.
\(^4\) See FN1.
\(^5\) Tversky & Kahneman, Supra Note 2.
\(^6\) Id, at 297.
The standard of liability surrounds our life. Be it driving, playing sports or seeking medical attention it has become a central legal instrument to determine rights and wrongs in civil life. The standard of liability does not only influence individuals, it also has a profound effect on corporations, municipal authorities’ and governments. In the field of law and economics, the standard of liability plays an important role. From the Hand formula and Coase theorem to Shavell’s accident model, the analysis of accidents was often considered the “jewel” of law and economics. During the past several years, prominent voices called for the use of insights from psychology and decision making theory in the economic analysis of law. The thesis aims to answer this call by proposing an adjustment to the traditional economic analysis of accidents in accordance with the theoretical and empirical knowledge in the field of decision making, mainly those of PT.

The findings of PT have a unique importance to any economic analysis dealing with uncertainty. It provides a more accurate account of human behavior and, most importantly, it may have significant implications on the manner in which individuals’ utility should be measured. The thesis aims to explore these effects with respect to the standard of liability. This goal may best be presented by a simple example: Jack is constructing a building in a residential site. John walks by the site every day on his way home from work. Despite regulations, a small probability exists that a brick will fall and harm John. However, a net exists that can prevent the accident. In a negligence regime, should Jack's liability be determined solely according to objective harm and probability or will utility be maximized if subjective preferences and perception of risk are taken into account? How will the parties'
behaviors change under the new liability standard and what are the more general implications?

To answer these questions the thesis is structured as follows: Part II gives a brief literature background of the traditional law and economic approach\(^{10}\) and previous related work. Part III presents the finding of PT and argues for their normative implication on the measurement of utility. Part IV provides a model and Part V discusses implications and possible critique of the changes in the liability standard proposed by the model. Part VI discusses the limitations of the proposed model and part VII concludes.

Two preliminary qualifications: The thesis focuses on victims which are either individuals or small business. This is done both because the two groups are often found in the plaintiff seat and because they are usually unable to engage in de-biasing activities.\(^{11}\) It is therefore assumed that victims are ‘bound’ to their subjective perception of risk, as portrayed by PT. The injurers in the model are either subject to PT, similar to the victims, or perceive risk as the economically rational person. Second, although examples are taken largely from cases of product liability, the proposed model comprehends all types of accidents.

2. Background: The Traditional Law and Economic Approach to negligence

2.1 The Learned Hand Formula. In 1947, judge Learned Hand gave his famous decision in *U.S. v. Carroll Towing Co.*\(^{12}\) known as the Hand Formula. The Hand Formula is nothing but a straight forward, economic analysis of negligence. It requires considering the

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\(^{10}\) The term ‘Traditional Model’ refers to Shavell’s model, in Shavell, S., *HANDBOOK OF LAW AND ECONOMICS*, vol. 1, Ch. 2, Polinsky M. & Shavell S., eds., (Elsevier B. V., 2007)

\(^{11}\) An exception may be insurance. However, the willingness to pay for insurance may also be affected by the liability standard.

\(^{12}\) 159 F.2d 169 (2d. Cir. 1947).
probability of harm (P), its value (H) and the costs of preventing it (C). The injurer is found liable iff the cost of (untaken) precautions is smaller than the expected harm it would have prevented (C<PH).\textsuperscript{13}

The importance of the Hand formula came into doubt by the Coase Theorem.\textsuperscript{14} Under the theorem, a legal rule has no significance to overall welfare, as long as transaction costs are low enough to allow bargaining. The underline assumption of the theorem - low transaction costs - was soon challenged by Calabresi and Melamed.\textsuperscript{15} Accidents, by their nature, are unintended and unplanned and, for example, a large pool of potential victims and injurers makes bargaining costly and unlikely.\textsuperscript{16} Calabresi and Melamed proposed a division between liability rules and property rules along the lines of the magnitude of transaction costs. In general, liability rules should be preferred when transaction costs are high. The Hand formula can thus be seen as substituting the need for actual bargaining and providing a ‘pre-made’, efficient, bargaining result.\textsuperscript{17}

2.2 The Traditional Accident Model: A Brief Description.\textsuperscript{18} The traditional model is the formalization of the law and economic approach to accidents. It has two basic setting: unilateral accidents, where only the injurer can take precautions and bilateral accidents where both injurers and victims can take precautions to prevent the accident.\textsuperscript{19} In both settings the model usually assumes that the parties have full information and act as the
economical rational person. The model further assumes that both the costs of precautions (x - for the injurer and y - for the victim) and the probability of accident (P(x,y)) are functions of the amount of taken precautions.\footnote{In the unilateral model - P(x).}

In the unilateral settings, given a certain amount of benefit (Bi) and harm (H) the social welfare function is: $S=Bi-x-P(x)H$ and it is maximized when $x'=P'(x)H$.\footnote{Note that x and y represent both the amount of precaution and its cost} Both negligence and strict liability incentivize the injurer to take the optimal amount of precaution ($x^*$).\footnote{Shavell, supra note 10.} However, strict liability was found superior to negligence with respect to the activity level problem.\footnote{Id, at 143-5.} In the bilateral settings, the socially optimal amount of precaution is achieved when $x'=P'(x,y^*)H$ and $y'=P'(x^*,y)H$.\footnote{Id, at 144-6.} The activity level problem asks whether the injurer will engage in the optimal amount of activity, as opposed to taking the optimal amount of precaution when the activity is undertaken.\footnote{Id, at 144-6.} The social welfare function in bilateral accidents is: $Bi + Bv – x – y – P(x,y)H$.\footnote{Either in the liability rule itself or as a defense to strict liability.} Only under a liability regime that incorporates negligence\footnote{Either in the liability rule itself or as a defense to strict liability.} will both the injurer and victim take due care.\footnote{Id, at 144-6.} Moreover, no legal regime induces optimal activity level.\footnote{Specifically, only the residual risk bearer will be incentivized to take an optimal level of activity, see Id, at 147.} As can be seen, the traditional model reaches results similar to the Hand formula\footnote{For a comparison between the traditional model and the Hand formula see Miceli T. J., THE ECONOMIC APPROACH TO LAW P. 25-28 (Stanford University Press, 2nd ed., 2009).} and seems to provide a formal proof for its efficiency.

In light of the widespread usage of negligence as the basis for liability\footnote{Dari-Mattiacci & Parisi, supra note 16, at 4.} and the use of the Hand formula to determine the standard of liability in both civil and common law countries,\footnote{See e.g., Van Dam, C., EUROPEAN TORT LAW (2006), P. 805, stated that the Hand formula is also used in civil law countries; European Group on Tort Law, PRINCIPLES OF EUROPEAN TORT LAW, Ch. 4 (2005).} the model is of great importance to legal practice as well as theoretical enquiry. It provides a positive as well as a normative perspective on accidents and is the starting point for most of the literature on the economic analysis of accidents.
2.3 The Traditional Model and Attitude towards Risk. Despite being based on economic analysis, when used in practice the Hand formula produced results, which both lay people and legal scholars find unacceptable, unfair or unjust. The most notorious example of such results may be the Ford Pinto case. In the Pinto case a jury refused to adhere to evidence presented by Ford, clearly indicating that, under the Hand formula, Ford should be found not liable. The California appellate court then affirmed the jury's verdict, dismissing in its decision the supremacy of the Hand formula and its underline economic analysis as the sole basis for the standard of liability.\(^\text{32}\) The Ford case is not an abnormality in the legal world nor should it be viewed as a legal mistake. In many states in the US, which one might expect to lead the use of the Hand formula, courts have abounded the formula altogether in favor of alternative doctrines such as consumer expectations.\(^\text{33}\) This trend was explored by Kysar, who pointed out that: "[Courts] worry that the risk-utility test fails to capture the full spectrum of concerns relevant to products liability law and its goal...".\(^\text{34}\) He then added that: “The emergence of products liability law reflected a concern among judges that the interests of consumers were not receiving adequate expression in modern product markets.”\(^\text{35}\) Similarly, Edie noted that a liability system based on expected utility will not be able to effectively attend to people’s concerns and preferences.\(^\text{36}\) Such liability system might impose a high standard of care when people perceive expected harm to be low and a low standard of care when people prefer it to be higher. As was pointed out by Guthrie “\(\text{Holding}\)\(^\text{32}\) For a more thorough discussion see part 5.5. For an overview of the Ford Pinto case: Leggett, C., ‘The Ford Pinto Case: the Valuation of Life as It Applies to the Negligence-Efficiency Argument’, Law & Valuation (1999).
\(^\text{34}\) \(\text{Id.}\) at 1704.
\(^\text{35}\) \(\text{Id.}\) at 1745.
imperfectly rational people to the “reasonable person” standard is akin to imposing absolute or strict liability on them.”

The critic of the current liability standard is not limited to legal scholars. One example is Slovic's comprehensive study on individuals' perception of risk. Slovic presented to subjects 90 different risky activities, ranging from hunting and food coloring to X-rays diagnostics. He then asked them to rate the risks and benefits of each of the activities. The study found that people perceive most activities to involve an 'unacceptable amount of risk'. It is important to note that the study defined the acceptable amount of risk in economic term: “a level which is good enough […] the advantages of increased safety are not worth the cost”. Slovic concluded that: “The gap between perceived and desired risk levels suggest that people are not satisfied with how the market and other regulatory mechanisms have balanced risks and benefits”.

The refusal of courts and juries to implement the Hand formula and the common perception that risk levels are unacceptable may indicate that the current liability standard fails to attend to peoples' preferences and, by extension, to maximize their welfare. This failure may well be the result of the current standard's disregard of subjective perception of risk and its assumption of risk neutrality. To solve these problems, some retuning to the traditional model and, especially, the incorporation of individuals' perception of risk, may be in order.

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39 Id, at 139.
40 Id, at 223.
42 See Guthrie, supra note 37, at 1127.
2.4 Relation to Previous Work. Although not many papers discuss incorporating subjective perception of risk into the analysis of accidents, some previous, important work has been done. In 2007 Edie\textsuperscript{43} Presented a rank dependence unilateral model of accidents that took into account rank dependence and expected utility to predict injurers’ behavior. Bigus\textsuperscript{44} used a weighing function based on prospect theory\textsuperscript{45} to predict injurer’s decision making in a unilateral model. However, unlike this thesis, both papers did not incorporate the perception of risk into the liability standard nor consider justifications to do so. Their predictions of behavior and analysis of results were, therefore, based solely on the liability standard of the traditional model.

Another line of related work is one concerning ambiguity aversion. Teitelbaum\textsuperscript{46} offered a unilateral accident model which used ambiguity aversion to predict injurer’s behavior. However, like Edie and Bigus, the liability standard used in the study remained the one of the traditional model. Franzoni\textsuperscript{47} later offered a bilateral accident model that included ambiguity and risk aversion both as predictors of behavior and as a base for the liability standard. Ambiguity aversion, however, describes a phenomenon different than the one described by PT. While ambiguity aversion is a response to uncertainty regarding the information about the probability of an accident,\textsuperscript{48} perception of risk describes one’s attitude to information about probabilities which he does not doubt.\textsuperscript{49} For example, an injurer who

\textsuperscript{43} Eide, supra note 36.
\textsuperscript{45} For discussion on the value function see part 3.1.
\textsuperscript{47} Franzoni, supra note 17.
\textsuperscript{48} Teitelbaum explained ambiguity as: “an agent's lack of confidence in his belief about the probability of uncertain events.” Teitelbaum, supra note 46, at 442.
\textsuperscript{49} As explained by Tversky & Fox: “A choice model that is based on a nonlinear transformation of the probability scale [such as PT] assumes that the decision maker knows the probabilities associated with the possible outcomes.” Tversky, A. & Fox C. R. ‘Weighing Risk and Uncertainty’ 102 Psychological R. 269
knows only the mean probability of an accident, which will lead him to increase the amount of precaution and at the same time perceive the mean probability as lower than it objectively is, which will lead him to decrease the amount of taken precaution. The two phenomena therefore can be seen as complementary and together may be considered as a more complete description of human behavior and preferences. It should already be noted that a model which assumes full and complete information, as the proposed model, is not affected by ambiguity aversion.

3. Prospect Theory

3.1 Prospect Theory - Description. Law and economics literature usually portrays the decision making process in lines of expected utility theory. The decision-maker is expected to know or inquire about the objective probabilities and values of potential events and decide on the alternative that will maximize her utility. In recent years, the utility function of the decision-maker shifted from risk neutrality to one depicting risk aversion. The shift to a concave utility function seems to represent not only acknowledgement of the field of decision making, but also an understanding that welfare has a profound subjective feature. Risk aversion describes the decision-maker attitude towards losses and gains. However, this is only one part of her overall attitude towards risk. Another equally important part is her
subjective perception of probabilities.\textsuperscript{53} As will be discussed below the two parts are at the heart of PT’s description of decision making under uncertainty.

Prospect Theory is a theory of decision making which describes a deviation from expected utility theory.\textsuperscript{54} According to the theory, decision making is a two stage process:

\begin{quote}
“Framing and valuation. In the framing phase, the decision maker constructs a representation of the acts, contingencies, and outcomes that are relevant to the decision. In the valuation phase, the decision maker assesses the value of each prospect and chooses accordingly”.
\end{quote}

The valuation stage itself is comprised of two distinct parts: A valuing part, transforming objective gains and losses into subjective (perceived) values and a weighing part, where objective probabilities are ‘transformed’ into subjective ones. It is important to emphasize that these effects are not a matter of choice, but rather an automatic and systematic process that the decision-maker cannot or will find it hard to control.\textsuperscript{56}

Before going into some details, it might be useful to keep in mind the main conclusion of PT known as the “fourfold pattern”: “risk aversion for gains and risk seeking for losses of high probability; risk seeking for gains and risk aversion for losses of low probability.”\textsuperscript{57}

\textit{Framing.} The first stage of the decision making process is framing the different, possible outcomes by the decision-maker. Contrary to expected utility theory, PT showed that the representation of the possible results as either losses or gain has a significant effect

\textsuperscript{53} Tversky & Kahneman, supra note 2, at 303.
\textsuperscript{54} Id, at 297.
\textsuperscript{55} Id, at 299.
\textsuperscript{57} Tversky & Kahneman, supra note 2, at 297. For discussion: Guthrie, supra note 37, at 1115–1120.
on the final decision. This deviation from expected utility theory is called the “Framing Effect”. The Framing effect represents the different valuation of losses and gains and the difference in the perception of probability, depending on whether they relate to losses or gains. In other words, framing an event as either a loss or a gain influences the perceived value and probability of its possible outcomes. The point around which event are framed (i.e., the neutral outcome or status quo) is called the reference point.

The following experiment provides a vivid example of the framing effect: Subjects were divided into two groups. One group was asked to imagine that they were given 2,000 and had to choose between: (a) 50% of losing 1000 or (b) losing 500 for certain. The second group was asked to imagine they were given 1000 and had to choose between (a) 50% of winning 1000 and (b) winning 500 for certain. Although the expected outcomes of the two games are identical, most subjects in the first group chose the certain (smaller) gain, while most subjects in the second group chose the uncertain (higher) loss. These results demonstrate how framing events as either a loss or a gain highly influence eventual decisions.

The Value Function. The value function represents the manner in which the decisionmaker transforms objective values (i.e., gains and losses) into subjective ones. In general, gains (outcomes right to the reference point) are described by a concave value curve while losses by a convex one. Based on empirical evidence, Kahneman and Tversky suggest the

60 No currency was indicated.
62 In the main experiment: “On a typical trial, the computer displayed a prospect (e.g., 25% chance to win $150 and 75% chance to win $50) and its expected value [...] The subject indicated a preference between each of the seven sure outcomes and the risky prospect” Tversky & Kahneman, supra note 2, at 305.
following value functions: \( v(y) = \lambda y^\beta \) for losses and \( v^+(y) = y^\alpha \) for gains \((\alpha, \beta = 0.88 \text{ and } \lambda = 2.25)\).\(^{63}\)

**Graph 1: PT Value Function**

![Graph 1: PT Value Function](image)

Source: PT.

_The Weighing Function._ The weighing function represents subjective perception of probabilities and, similar to the value function, is different for probabilities linked for losses and gains. According to PT, the weighting function for losses is: 

\[
W^-(p) = \frac{p^\delta}{[p^\delta + (1-p)^\delta]^{1/\delta}}
\]

and for gains 

\[
W^+(p) = \frac{p^{\gamma}}{[p^{\gamma} + (1-p)^{\gamma}]^{1/\gamma}}, \text{ where } \gamma = 0.61 \text{ and } \delta = 0.69.\(^{64}\)

**Graph 2: PT Weighing Function**

![Graph 2: PT Weighing Function](image)

Source: PT.

\(^{63}\) Tversky & Kahneman, supra note 2, at 309–314.

\(^{64}\) _Id._
The weighing function together with the value function represents the decision-maker attitude towards risk. Their combined effect on the decision-maker perception of risk is the ‘fourfold pattern of risk attitudes’ described in the beginning of this section.

3.2 The Normative Implication of Prospect Theory. The first and most important question presented in the thesis is whether PT has normative implications on the manner in which legal rules should be constructed. PT was never claimed by its authors to be a normative theory in an economic sense. Moreover, it violates normative economic principles such as invariance. However, its implication on the measurement of utility cannot be ignored. The normative claim to follow is a normative claim in a weak sense. It does not challenge the premise of the law and economics, that the law should maximize overall welfare; however, it does propose an alternative route in which utility should be measured. By providing a better understanding of individual’s perception and attitude towards risk PT enables adopting a more accurate utility function, one that better reflects people’s preferences and utility. As is argued bellow, this insight regarding individuals' utility should be taken into account when legal rules, such as the liability standard, are constructed.

Before moving into the main arguments two qualifications must be addressed. First, the use of PT as part of law and economics should only be done in an ex-ante prospective (i.e., before the risk is realized). This is somewhat self evident since after the risk is

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65 Id.
67 Id.
68 For a discussion of the normative aspect of framing effect see: Fischer, G. W., et al, ‘Risk Preferences for Gains and Losses in Multiple Objective Decision Making’, 32(9) management science 1065 (1986), at 1082-1083. Edie briefly mentions the possibility that the weighing and value function should be considered as part of the social welfare, see Edie supra note 36.
realized\textsuperscript{69} there is no longer a meaning to the concept of subjective attitude towards risk. In other words when there is no longer any uncertainty, a theory of decision making under uncertainty does not provide any meaningful input regarding the structure of legal rules. Needless to say that a requirement of an ex-ante approach cannot be justified simply by the desire to use PT’s finding. In order to do so, an independent theoretical justification must be found. Regarding the standard of liability, such justification is found in the concept of deterrence. Deterrence has long been considered the main purpose of accidents law.\textsuperscript{70} To achieve efficient deterrence a strict ex-ante approach is required, i.e., actions and outcomes are to be assessed before the risk is realized. The goal of deterrence therefore justifies the ex-ante approach required for the usage of PT in the analysis of accidents.

The second qualification is a subjective welfare approach. A subjective welfare approach\textsuperscript{71} assumes that people’s subjective preferences have a significant influence on their welfare.\textsuperscript{72} Since PT is concerned with subjective perception of risk, any account of welfare which is strictly or mainly objective means that PT has no or minimum effect on people's welfare and therefore on the economic analysis of legal rules. A thorough discussion on the different approaches to welfare is beyond the scope of this thesis. However, the subjective welfare approach is well grounded in the law and economic literature. To use the words of

\begin{flushright}
69 Or after there is no longer any risk. Because, for example, the risky activity no longer undertaken.
70 Shavell, S., ‘Economic Analysis of Accident Law’, NBER working paper 9694 (2002); Dari-Mattiacci & Parisi, supra note 16.
71 A more refine definition may be: "Full information preferentialism [which] permits the “laudering” of non-ideal or disinterested preferences yet retains the basic attraction of preferentialist accounts of well being". Adler & Posner, supra note 52, at 257.
\end{flushright}
Sunstein: “The standard economic emphasis on people's subjective preferences has the considerable advantage of attending to what people care about.”

With the above two restrictions in mind, we can address the argument at hand: does PT have normative implications on the economic analysis of the law. The first argument to support this claim is based on the premise, to be discussed below, that PT represents genuine subjective preferences.

PT describes the decision making process of individuals. However, this by itself is not sufficient to justify referring to it as depicting real preferences. People are limited in their decision making capabilities and are subject to heuristics, biases and other false beliefs that hinder their judgment. Heuristics, for example, are often described as “mental shortcuts” in the decision making process and the use of heuristics is usually attributed to lack of information or bounded rationality. Although sometimes useful, heuristics often lead people to decide differently than they would have given full information and superior cognitive capabilities. Similarly, biases and false beliefs often represent lack of statistical or other relevant information. The final result being that, if individuals had perfect cognitive ability and information, they may have decided differently. For these reasons, heuristics and biases are not considered to represent genuine preferences, but a cognitive mistake caused by the lack of cognitive capabilities or information. It would be hard to

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77 On the differences between biases and preferences see Harvey, supra note 56.
79 Tversky & Kahneman, supra note 56; Sunstein, supra note 75.
claim that such mistakes have normative implications and indeed much of behavioral law and economics is aimed at de-biasing (i.e., undoing) their effects.\textsuperscript{80}

To consider PT as having normative implication, it first needs to be distinguished from such phenomena and indeed important differences can be pointed out.\textsuperscript{81} Consider the setting of the experiments on which PT was based on:\textsuperscript{82} a simple, abstract ‘gambling game’, where subjects were asked to choose between, for example, an uncertain (large) loss and a certain (small) loss. In these setting, the decision-maker is provided with full information and the decision requires minimal cognitive capabilities. It seems reasonable to conclude, that the findings of PT and the effects they describe are not the result of lack of information\textsuperscript{83} nor are they the result of bounded rationality or other cognitive limitations. Not only that, the abstract gambling game seems to decrease the relevance of prior beliefs or experience and relatively small reliance on emotions and memories is likely to come into play. In that sense, the findings of PT do not seem to represent any failure or mistake stemming from people’s bounded rationality. On the contrary, PT's findings are to be considered as representing individuals' subjective preferences.\textsuperscript{84} In that sense they are more similar to the well accepted concept of diminishing marginal utility.\textsuperscript{85} To conclude this part it may be best to refer to Harvey who noted:

\begin{quote}
“The recognition of these effects [such as those described by PT] in the model is to be regarded as the inclusion of a preference issue of
\end{quote}

\textsuperscript{80} See e.g., Sunstein, supra note 75; Guthrie, supra note 37.

\textsuperscript{81} On the differences between PT and biases see Harvey, supra note 56.

\textsuperscript{82} See FN62.

\textsuperscript{83} For a brief description of the experiment see FN62. In another example, Guthrie, supra note 37, described the following experiment regarding individuals' attitude towards risk: “When choosing between paying a definite $50 fine and facing a 5\% chance at having to pay a $1,000 fine, individuals tend to make the risk-averse choice and opt to make the sure payment.”

\textsuperscript{84} Franzoni made a similar argument, see Franzoni, supra note 17, at 5-6.

\textsuperscript{85} As was proclaimed by the authors themselves, see Tversky and Kahneman supra note 2, at 303.
importance to the person rather than as the inclusion of systematic
imperfections in the person's reasoning." 86

Accepting PT as a theory that genuinely represents people's preferences has
important implications on the measurement of their utility. Mainly, under the assumption of
a subjective welfare approach, utility should be measured while considering people's attitude
towards risk, as described by PT. The reason being, that a welfare approach that has a
substantial subjective part requires incorporating peoples' preferences to maximize their
welfare. 87 Taking only objective probabilities and values into account, while disregarding
subjective preferences will create a welfare loss, steaming from the difference between the
'objective' reality and the perceived one. For example, forcing a person to enter into a lottery
that has a positive, objective expected utility and a negative, subjective one will, ex-ante,
decrease his welfare. Therefore, if PT describes genuine preferences, considering its insights
is vital to maximize social welfare. When it comes to accidents, this requires taking PT into
account when constructing the liability standard.

The normative implications of PT can also be deduced by an analogy to the manner
in which efficiency is viewed in the economic analysis of contracts. 88 It seems that the basic
premise of contract law and economics is the well accepted Bargaining Theory. According
to the theory, parties will, in general, reach an efficient contract as long as they are equally
informed and acting on their own free will. 89 Since the bargaining parties themselves are
influenced by their subjective perception it could be argued that the efficient solution
described by the Bargaining Theory is one that takes subjective perceptions of risk into

86 Harvey, supra note 56.
87 Similarly, Posner’s noted: “Should Accident Insurance Premium be added to the Hand Formula?” Posner,
R. A., ECONOMIC ANALYSIS OF LAW, Ch. 6 (Aspen Publishers, 8th ed., 2010).
88 This argument is based on Franzoni, supra note 17, which is further discussed bellow.
89 For discussion: Cooter R. & Ulen T., LAW & ECONOMICS, Ch. 6 (Pearson Education, 5th ed., 2008).
account. For example, when contracting on the transfer of property, the parties are likely to be influenced by the framing effects as well as their perception of the risks in the real estate market. Despite these effects, such arms-length transaction is usually considered to be efficient in the law and economics literature. If this is the true, it is hard to find a good reason why subjective perception of risk should be rejected in when considering the efficient solution in tort, while it is accepted in contract law.

Contract theory ideas can also be applied to the liability standard directly, since, as was briefly mentioned before, the liability standard could be seen as an ex-post contract. As noted by Franzoni: “The fully efficient outcome [in accidents] is the one that parties themselves would agree to if they could write an ex-ante contract specifying the level of precaution”. Similarly, Kysar, with respect to product liability, stated that the level of care should mimic the (theoretical) bargaining result that would have been agreed upon between manufacturers and consumers. He then added that consumers: "are entitled to the benefit of the hypothetical safety bargains that they would have struck with manufacturers, given a more textbook market setting." If the efficient solution is the one the parties would have reached by bargaining, it is reasonable to assume that it too would be influenced by their subjective perception of risk. To give an example, when an employee and employer negotiate a contract, they have in mind, inter alia, the risks the employee will face in his work. Given that the two have full information, we can expect that the salary agreed upon will reflect their subjective perception of the risk and not its objective properties. If the

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91 See e.g., Guthrie, supra note 37; Korobkin, supra note 90.
92 For critic see e.g., Guthrie, supra note 37.
93 Franzoni, supra note 17, at 15.
94 Kysar, supra note 33, at 1749.
95 Id.
standard of liability should reflect a similar bargaining result, it too should take into account subjective perception of risk.

Unlike actual bargaining, the liability standard cannot address each individual's unique perception of risk. Instead it has to use an average of such perceptions. However, this approach has its justifications, as noted by Poser: “Courts do not attempt to measure the actual costs to the parties [...] Rather they estimate the accident-avoidance costs of the average (reasonable) person [...] This approach is justified by the cost of individualized measurement”.  

Another insight from contract law is one regarding default rules. Since, as mentioned above, the liability standard can be seen as replacing actual bargaining, it might also be analyzed using contract theory concept of default rules, i.e., as providing a pre-made rule that would apply unless agreed otherwise. The liability standard is likely be categorized as a majoritarian default rule as opposed to a penalty rule. This is because it is unlikely that the purpose of the liability standard is to solve problems such as asymmetric information. A majoritarian default rule is efficient when it depicts the choices of most people. In that respect, a liability standard based on PT seems to better represent people's bargaining choices compared to the traditional model that neglects individuals’ attitude towards risk. Therefore, it is likely to be a more efficient choice as a default rule.

Another argument to consider PT as having normative implications concerns markets that involve risk. Many markets, such as the stock exchange and the insurance market involve uncertainty and are influenced by individuals’ perception of risk. In the insurance market, for example, even under an assumption of full information, individual's subjective

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96 Posner, supra note 87, at 218.
98 Id.
perception of risk will determine their willingness to pay.\textsuperscript{99} It therefore could be argued, that only if PT is considered as having normative implications on the measurement of utility, could these markets be considered as able to reach an efficient equilibrium. To put it differently, if subjective perception of risk is considered a cognitive mistake then, since such ‘mistake’ is almost unavoidable, efficient equilibrium is improbable in these markets. If, however, one believes that despite the effect of subjective perception of risk, these markets can reach an efficient equilibrium, it seems reasonable to conclude that he should also accept subjective perception of risk as having normative implications.

A different type of argument is one based on the value of autonomy. Autonomy is the right of individuals to decide according to their own free will and was long argued to be an important individual right. Autonomy did not remain solely an abstract right, but one that conveys a monetary value. For example, courts have awarded monetary compensation for its breach.\textsuperscript{100} Autonomy is also independent of the rationality of the decision or the decision-maker: “Suppose that people's choices often go wrong [...] it remains true that freedom of choice should be counted as both an intrinsic and an instrumental good [...] it is an insult to their autonomy to deny them the right to choose, even if their choices do not promote their welfare”.\textsuperscript{101}

Considering attitude towards risk, we could expect that a free, autonomous decision is one based on the individual's perception of risk. Therefore, applying a liability standard that neglects such perception may impose a level of risk that poorly reflects individuals' free choice and therefore harms their autonomy. Assuming that autonomy has an intrinsic value,

\textsuperscript{99} See Slovic, supra note 38, Ch. 3&9.
\textsuperscript{100} For example, both in CA 2781/93 Daaka v. “Carmel” Hospital, IsrSC 80(4) 526 and CA 10085/08 Tnuva V. Tophee Rabi, IsrSC (2011), the court awarded monetary damages for infringement of people's autonomy. See also Adini R., ‘Bulletin on Class Actions and Derivative Claims' (Dec. 2011).
\textsuperscript{101} Sunstein, supra note 72; See also Twerski & Cohen, supra note 59.
we can conclude that a liability standard which better simulates free choice may increase overall welfare, even if, autonomy aside, it is less efficient. Therefore, if a liability standard that incorporated PT better reflects individuals' preferences, it is likely to be less harmful to their autonomy and thus, in that respect, welfare increasing.

To assess the overall effect on welfare however, one should consider the following: An argument based on the intrinsic value of autonomy allows relaxing the previous assumption of a subjective welfare approach and only assume that autonomy has some intrinsic value. Let us consider a perfectly objective welfare approach. Under this approach, the subjective perception of risk is of no relevance to the measurement of utility and therefore, the liability standard of the traditional approach provides the efficient solution in the narrow sense. In a broader view however, one should compare these efficiency benefits with the utility loss created by the harm to individuals' autonomy. In other words, while under an objective welfare approach the traditional model results in a more efficient liability standard, this standard also has a utility loss due to its infringement of individual autonomy. On the other hand, a liability standard that incorporates PT, might be less efficient, but at the same time is more likely to be in line with individual choices and therefore less detrimental to their autonomy. The benefits from setting the standard of care more efficiently should be weighed against the utility loss it creates by harming individuals' autonomy. Should the cost be greater than the benefit, a model based on subjective perception of risk should be preferred.

Another type of argument is one regarding the value of fairness. Just as a liability standard might infringe individuals' autonomy, people may also consider it unfair. For example, imposing an unacceptable amount of risk on individuals, one that they would not have freely agreed to, can be considered as an unfair action. It should also be noted that
people do not have to perfectly understand the law to regard it as unfair. For example, it might be sufficient that they merely read the facts and legal results in a newspaper and be aware that they are exposed to the risk.

Jolls Sunstein & Thaler found that people often prefer fairness to their own self interest. They conclude that fairness is part of most agents’ utility. Moreover, utility from fairness is not restricted to individuals', but was also found when corporate actions were analyzed. Similarly to the autonomy argument, if fairness is part of individuals' welfare, then a liability standard that is (perceived) to be unfair may be welfare detrimental. A cost benefit analysis in the same lines as presented with respect to autonomy is required to compare the overall welfare effect of the two types of liability standard. A liability standard based on subjective perception of risk should be preferred, as long as the increase in utility from a fairer standard is greater than any decrease in welfare it might create.

A final and perhaps extreme argument for considering PT as having normative implications is based on Slovic’s argument on individuals' “alternative rationality”:

“Public’s concern could not simply be blamed on ignorance or irrationality. Instead, [...] the public’s reactions to risk [...] can be attributed to a sensitivity to technical, social and psychological qualities of hazards that are not well modeled in technical risk assessments [...] I shall argue for a conception of risk that is starkly different from this traditional view. This approach highlights the subjective and value-laden

103 Kahneman et al, supra note 102.
104 As defined by Sustain, see Sunstein, supra note 74, who further provides a critical discussion on Slovic’s position. It should be noted that his argument is not necessarily based welfare maximization.
nature of risk and conceptualizes risk as a game in which rules must be
socially negotiated within the context of a specific problem”.

Slovic offered a different approach to risk itself the does not distinguish between different
cognitive phenomena. He claimed that individuals’ overall subjective perception of risk is
by no means inferior to the technical-rational one, and should be considered as its
alternative. Moreover, he claimed that the definition of rationality itself is controlled by
whoever controls the definition of risk. If one accepts Slovic’s argument, it is only
reasonable to take such alternative rationality into account when constructing the liability
standard. It seems that, as a well accepted decision making theory, PT should be considered
an important part of any concept of alternative rationality based on individuals’ subjective
perception and therefore should be part of any legal rule based on such alternative
rationality.

The normative implication of PT on the economic analysis of law can be justified on
many grounds. From the notion that maximizing welfare requires taking subjective
preferences into consideration, through an analogy to contract law and bargaining theory and
up to the intrinsic value of autonomy and fairness. Each of arguments in itself sufficient for
PT to be taken into account in the economic analysis of accidents and combined, I believe,
they provide sufficient evidence for subjective perception of risk to be an integral part of any
welfare maximization endeavor.

The following part IV provides a model incorporating PT into the liability standard.
In a general sense, it can already be said that incorporating PT in any legal analysis would

105 See Slovic, supra note 38, at 392. Kysar, supra note 33, at 1767 noted: “Many aspects of consumer beliefs
and behavior [which depart from expected utility theory] can be said to represent a rival rationality that is
wider in scope and richer in detail than the stark logic of risk-utility analysis.”
106 “Whoever controls the definition of risk controls the rational solution to the problem at hand”, Slovic,
supra note 38.
reflect the ideas of the fourfold pattern. Mainly, risk aversion for low probability large magnitude outcomes and risk seeking for high probability small magnitude outcomes.

4. The Proposed Model

4.1 Assumptions. The following unilateral and bilateral models incorporate PT into the traditional model. The proposed model assumes that the injurer and victim can choose an amount of precaution from a continuous amount of precautions. For simplicity, x and y represents both the amount and cost of precautions. The model further assumes that both injurer and victim have full information regarding the probability of accident P(x,y) (and P(x) in the unilateral model), the benefits of the risky activity (Bi and Bv respectively) and the amount of harm (H) caused by an accident. Courts are assumed to set damages (D) equal the harm and a liability standard (x^) equal to the optimal level of precaution (x*).107 Finally, the model assumes that no bounded rationality or other cognitive effects influence the agents' behavior, expect those described in part 3.1 (i.e., those described by PT). For that reason, the parameters (α, β and λ) used in the model are given the same values as in PT.108

4.2 Framing. Before discussing the model itself, we first need to determine the manner in which people naturally frame accidents. Part 3.1 discusses the significance of framing. It notes that a change in the reference point changes individuals' perception of outcomes and might eventually lead to different decisions. Predicting the manner in which individuals naturally frame risky prospects is a difficult task.109 To do so one must first

108 See discussion in part 3.1.
109 For example, Fischer et al, supra note 68, at 1082 stated: “there is no generally accepted basis for choosing a decision frame and establishing a reference outcome in prescriptive analysis. “ The difficulty in predicting
predict what will be perceived as the natural status quo (i.e., the reference point), to determine if the different outcomes will be perceived as a loss or a gain and whether the weighing and value function will be operated on each component separately or on the net outcome as a whole (i.e., will the outcomes be segregated or integrated).\textsuperscript{110}

\begin{align*}
\text{Predicting the Natural Reference Point} \\
\text{Predicting the Coding of Outcomes as Gains or Loses} \\
\text{Predicting whether Outcomes will be Integrated or Separated}
\end{align*}

In an accident model, the components relevant to framing are: the benefit from the activity, the cost of precaution and the expected harm. The following part first discusses the coding of each component as either a gain, a loss or part of the status quo and then considers whether segregation or integration are more likely to naturally occur.

Considering first the benefit from the risky activity, it seems that there are two relevant plausible frames. First, intuitively, the benefit can be naturally framed as a gain \((v(B)=\text{Bi}^0)\).\textsuperscript{111} However, an alternative framing possibility is the assimilation of the benefit into the status quo \((v(B)=\text{Bi})\). In an accident model, the benefit is certain to occur and has a fixed magnitude. This certainty can lead the benefit to be assimilated into the status quo, just as the next paycheck is assimilated into an employee’s status quo even before it is

\textsuperscript{110} Frames is also a result of difficulty in generalizing experimental results, see Casey, J. T., ‘Predicting Buyer-Seller Pricing Disparities’, 41(6) Management Science 979 (1995).


\textsuperscript{111} Note that the Parameters \(\alpha\), \(\beta\) and \(\lambda\) are given the same value as in PT. See part 3.1 for discussion.
received. It should be noted however that since the benefit is not part of the decision making process, its framing has little influence on the analysis' results. For simplicity, it will therefore be assumed that individuals naturally frame the benefit as a gain.

The second component of the model is the cost of precautions. It is important to first note that, counter-intuitively maybe, not every cost is framed as a loss. For example, when a seller gives away a good in return for money, the loss of the good is naturally framed by the seller as a gain, i.e., as “part of doing business”. Similarly, the cost of an insurance premium was found to be framed as a gain by the insured. In the same experiment however, when the cost was no longer represented as an insurance premium, but simply as choosing between a small, certain cost and a high, uncertain cost, most subjects framed the certain cost as a loss. The cost of precaution therefore can either be perceived as "part of doing business" or an insurance premium and be framed as a gain ($v^+(x) = x^n$) or it can be perceived as a simple, sure cost and thus negatively framed ($v^-(x) = -\lambda x^\beta$).

The third component of the model is expected harm. Like the cost of precaution, expected harm can also be considered as "part of doing business". However, unlike the cost of precaution, the expected harm is a probabilistic event and it is the only probabilistic event in the model. Therefore, it is more likely to be perceived in similar fashion to losing a bet or the occurrence of the insured event, than it is to the payment of the insurance premium. Both

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113 This is because the marginal analysis depends solely on marginal risk and benefits.
114 An exception may be with respect to the activity level.
115 See for example Casey, supra note 109.
losing a bet and the occurrence of the insured event are naturally framed as a loss and therefore it is likely that the expected harm will be similarly framed as a loss

\((W(P(x)))v(H) = W(P(x))\lambda H^\beta\).  

Considering the segregation/integration issue, the literature suggests that, in general, people do not spontaneously integrate outcomes. Most evidence indicate that people segregate between certain and probabilistic outcomes and between gains and losses. For example, Casey found that when deciding to purchase a certain good, buyers do not consider the net benefit of the transaction, but segregate between the buying price and the benefit from the good. Similarly, it seems that people segregate the cost of insurance premium from the loss incurred by the insured event. Although caution is advised, and additional empirical data will be of much use, it seems, at this point, that segregation is more plausible for an accident model.

From the discussion above, no one framing possibility can be assumed with certainty. However, two conclusions can be reached. First, it appears that segregation is more likely to occur. Second, the two most likely possibilities are either when both the cost of precaution and the expected harm are framed as a loss, yielding the social welfare function: 

\[ S = B^a - x^\beta - W(P(x))\lambda H^\beta \]

or where the cost of precaution is positively framed and the expected harm is negatively framed (\(S = B^a - x^\alpha - W(P(x))\lambda H^\beta\)). Because it is more

\[ 117 \text{ Most experiments dealing with framing are presented as lotteries and losing the bet is framed as a negative event. See e.g., Kahneman & Tversky, supra note 58; Fischhoff, supra note 110; Tversky & Kahneman, supra note 66.} \\
118 \text{ Fischhoff, supra note 44, seem also to have framed the expected harm as a loss.} \\
119 \text{ Bigus, supra note 44, seem also to have framed the expected harm as a loss.} \\
120 \text{ Bigus, supra note 44, seem also to have framed the expected harm as a loss.} \\
121 \text{ Fischhoff, supra note 110.} \\
122 \text{ See e.g., Tversky & Kahneman, supra note 66.} \\
123 \text{ Fischhoff, supra note 110.} \\
124 \text{ Fischhoff, supra note 110.} \\
125 \text{ See Casey, supra note 109. Thaler, argued that outcomes encoded in different ‘mental accounts’ are more likely to be segregated, see Thaler, R. H., ‘Mental Accounting and Consumer Choice’ 4(3) Marketing Science 199 (1985).} \\
126 \text{ Casey, supra note 109; Casey, supra note 112.} \\
127 \text{ Slovic, et al, supra note 116; Kahneman & Tversky, supra note 58.} \\
128 \text{ In a unilateral model.} \]
intuitive to consider the cost of precaution as a loss, the first framing option is used in the proposed model. However, a graphical representation of the model under the alternative framing is provided in Annex 1.

4.3 A Unilateral Model. As described in part III, PT provides for both a value and a weighing function to account for the subjective perception of risk. Let \( W(p(x,y)) \), describe the weighing function \( W^{-}(P) \) (i.e., individuals perception of probabilities linked to losses).\(^{125}\) For a certain \( B_i \) and \( H \), incorporating PT into the social welfare function of the traditional model yields the following social welfare function: \( S = B_i^n - \lambda x^\beta - W(P(x))\lambda H^\beta \). The optimal amount of precaution is therefore:\(^{126}\) \( \lambda \beta x^{\beta - 1} = -W'(P(x))P'(x)\lambda H^\beta \).

Compared to the traditional model, the use of PT has several implications on the level of due care. First, the marginal benefit side is affected by both the weighing and value functions. Due to the weighing function, the slope of the perceived probability is greater than that of the objective probability for small probabilities and vice versa for large probabilities:\(^{127}\)

\[
W'(P(x))P'(x) > P'(x), \text{ for small probabilities (large values of } x) \text{; and}
\]
\[
W'(P(x))P'(x) < P'(x), \text{ for high probabilities (small values of } x).
\]

The effect of the value function on the marginal benefit depends on the magnitude of harm and perceived harm is greater than objective harm for small magnitude of harm:

\[
\lambda H^\beta > H, \text{ for small values of } H; \text{ and}
\]
\[
\lambda H^\beta < H, \text{ for large values of } H.
\]

\(^{125}\) Because all the probabilistic events in the model are linked to loses, only the weighing function linked to losses is used.

\(^{126}\) From equating the derivative of the social welfare function to 0.

\(^{127}\) This can be clearly observed in Graph 2.
When combining the two effects, and in light of the fact that PT suggest risk seeking for high probability and risk aversion for low probability, it seems that the perceived marginal benefit \( (W'(P(x))P'(x)\lambda H^\beta) \) is greater than the objective marginal benefit \( (P(x)H) \) for small probabilities and vice versa for large probabilities. This is observable in Graph 3, where the function \( W(P(x))\lambda H^\beta \) is steeper than \( P(x)H \) for large values of \( x \) (i.e., small probabilities) and vice versa for small values of \( x \).

**Graph 3:** Expected Benefit of the Proposed and Traditional Models

![Graph 3](image)

In the marginal cost side, the perceived marginal cost is smaller than the objective marginal cost for high costs of precaution\(^{129}\) and vice versa for low cost of precaution.\(^{129}\)

\[
\lambda \beta x^{\beta -1} > x', \text{ for small values of } x;
\]

\[
\lambda \beta x^{\beta -1} < x', \text{ for high values of } x.
\]

The overall effect of PT on the optimal amount of precaution is somewhat ambiguous. In general, the level of due care seems to increase for accidents of small probabilities. In such accidents, the perceived marginal cost is lower than in the traditional model while the perceived marginal benefit is higher. However, an opposite effect is likely to occur regarding accidents of high probability, where incorporating PT is likely to lower

\(^{128}\) The data on which graphs 3 & 4 are based upon is provided in Annex 2.

\(^{129}\) Note that high costs of precaution usually coincide with low probability of accident.
the level of due care. A generalized comparison between the standard of care under the proposed model and the traditional model is presented in the following graph 4 and table 1.

Graph 4: Welfare Functions of the Proposed and Traditional Models

![Graph 4: Welfare Functions of the Proposed and Traditional Models](image)

Note: $x^{EV}$ represents optimal standard of care under the traditional model and $x^*$ under the proposed model.

Table 1: Effect on the Standard of Care of the Proposed Model in Comparison to the Traditional Model in Multiple Circumstances

<table>
<thead>
<tr>
<th>Magnitude of Harm /Probability</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (0 ≤ P &lt; .1)</td>
<td>Ambiguous</td>
<td>Exceed</td>
<td>Highly Exceed</td>
</tr>
<tr>
<td>Medium (.1 &lt; P &gt; .2)</td>
<td>Lower</td>
<td>Ambiguous</td>
<td>Exceed</td>
</tr>
<tr>
<td>High (1 ≥ P &gt; .2)</td>
<td>Lower</td>
<td>Lower</td>
<td>Ambiguous</td>
</tr>
</tbody>
</table>

Following is an analysis of injurer's and victim's behavior under the proposed model.

Negligence.

Proposition 1: An injurer subject to PT perception of risk takes due care. The utility function of an injurer subject to PT is:

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130 No definitive conclusion can be made however since the result depends on the magnitude of harm and costs of precaution.
\[ U_i = B_i - \lambda x^\beta - W(P(x))\lambda D^\beta \quad \text{if} \quad x < x^\wedge (= x^*) \quad (1) \]
\[ U_i = B_i - \lambda x^\beta \quad \text{if} \quad x \geq x^\wedge (= x^*) \quad (2) \]

In (1) the injurer maximizes his utility when \( \lambda \beta x^{\beta-1} = -W'(P(x))P'(x)\lambda D^\beta \), since \( D = H \) he takes due care. In equation (2), the injurer maximizes his utility when \( \lambda \beta x^{\beta-1} = 0 \). The minimum amount of precaution possible in this part is \( x = x^\wedge \) and here too the injurer takes the optimal amount of precaution.

**Proposition 2:** An injurer not subject to PT perception of risk might take due care.

The utility function of an injurer not subject to PT is:
\[ U_i = B_i - P(x)D \quad \text{if} \quad x < x^\wedge \quad (3) \]
\[ U_i = B_i - x \quad \text{if} \quad x \geq x^\wedge (= x^*) \quad (4) \]

In equation (3) the injurer’s maximizes his utility when: \( 1 = -P'(x)D \), the optimal amount of precaution under the traditional model (\( x^{\text{EV}} \)). In (4), the injurer maximizes his utility when \( x' = 0 \), i.e., he takes due care as discussed above. The injurer therefore takes due care iff:
\[
B_i - x^* \geq B_i - x^{\text{EV}} - P(x)D \\
= P(x)D \geq x^* - x^{\text{EV}}.
\]

The injurer takes due care iff the additional cost of precaution is smaller than expected harm.

*Strict liability.*

**Proposition 3:** An injurer subject to PT perception of risk takes due care. The utility function of an injurer subject to PT is: \( U_i = B_i - \lambda x^\beta - W(P(x))\lambda D^\beta \), i.e., identical to his utility function under negligence. Therefore, as discussed above, the injurer takes due care.

**Proposition 4:** An injurer not subject to PT perception of risk does not take due care.

The utility function of an injurer not subject to PT is: \( U_i = B_i - x - P(x)D \). The injurer chooses an amount of precaution meeting: \( 1 = P'(x)D \), i.e., \( x = x^{\text{EV}} \).
4.4 A Bilateral Model. In the bilateral model, the social welfare function is:

\[ S = B_i^\alpha + B_v^\alpha - \lambda x^\beta - \lambda y^\beta - W(P(x,y))\lambda H^\beta. \]

Maximizing the welfare function\(^{131}\) reveals that the optimal amount of precaution is \(\lambda \beta x^{\beta-1} = -W'_x(P(x,y^*))P'(x,y^*)\lambda H^\beta\) for the injurer, and \(\lambda \beta y^{\beta-1} = -W'_y(P(x^*,y))P(x^*,y)\lambda H^\beta\) for the victim. As in the unilateral case, for small probabilities, the level of due care under the proposed model is likely to be greater than under the traditional model.

**Negligence**

**Proposition 5:** An Injurer and a victim subject to PT perception of risk take due care.

For any given \(B_i\) and \(H\), the utility to the injurer from the activity is:

\[ U_i = B_i^\alpha - \lambda x^\beta - W(P(x,y))\lambda D^\beta. \]

As in the unilateral model, the injurer takes due care.\(^{132}\) The victim’s utility function, assuming that the injurer takes due care, is:

\[ U_v = B_v^\alpha - \lambda y^\beta - W(P(x^*,y))\lambda (H - 0)^\beta. \]

The victim maximizes his utility when \(\lambda \beta y^{\beta-1} = -W'_y(P(x^*,y))P(x^*,y)\lambda H^\beta\), i.e., he takes the efficient amount of precaution.

**Proposition 6:** An injurer not subject to PT perception of risk is likely take due care.

The injurer’s utility function is:

\[
\begin{align*}
U_i &= B_i - x - P(x,y)D & \text{if } x < x^\wedge & \quad (5) \\
U_i &= B_i - x & \text{if } x \geq x^\wedge & \quad (6)
\end{align*}
\]

In (5) the injurer maximizes her utility when \(1 = -P'(x,y)D\), i.e., when \(x = x^{EV}\). In equation (6), the injurer maximizes her utility when \(x^* = 0\), i.e., when \(x = x^\wedge = x^\wedge\). The injurer therefore takes due care iff:

\[ B_i - x^* \geq B_i - x^{EV} - P(x^{EV},y)D \]

\(^{131}\) From equating the derivatives of \(S'x\) and \(S'y\) to 0.

\(^{132}\) This conclusion is based in Shavell’s analysis of bilateral accidents, see Shavell, supra note 10, at 144-5.
\[ x^* - x^{EV} \leq P(x^{EV},y)D \]

The injurer chooses the efficient amount of precaution iff the additional cost of precautions is lower than expected harm.

*Strict Liability.*

**Proposition 7: Injurer and victim subject to PT perception of risk do not take due care.** Under strict liability the victim utility function is:

\[ U_v = B_v^\alpha - \lambda y^\beta - W(P(x,y))\lambda(H - H)^\beta = B_v^\alpha - \lambda y^\beta. \]

The victim therefore takes no care. The injurer utility function is: \[ U_i = B_i^\alpha - \lambda x^\beta - W(P(x,o))\lambda D^\beta. \] The injurer maximizes his utility when: \[ \lambda \beta y^{\beta - 1} = -W^*(P(x,o))P'(x,o)\lambda D^\beta. \] The injurer’s actual level of care, in comparison to the optimal level of care, depends on several aspects such as whether injurer and victim precautions are substitutes\(^{133}\) or complementary\(^{134}\).

**Proposition 8: Injurer not subject to PT perception of risk does not take due care.**

The injurer utility function is: \[ U_i = B_i - x - P(x,0)D \] and he maximizes his utility when: \[ 1 = -P'(x,0)D. \] As above it is hard to determine whether this leads to a level of care which is less or more than optimal.

4.5 Discussion

4.5.1 *Negligence and Strict Liability Compared.* In the unilateral model, when the injurer is subject to PT, both negligence and strict liability regimes induce optimal behavior. However, if the injurer is not subject to PT, strict liability does not induce efficient behavior, while negligence results in either due care or a level of care similar to that of strict liability.

\(^{133}\) Meaning that the precaution taken by the injurer can come instead of the victim's this may incentivize injurer to take more than optimal care.

\(^{134}\) Meaning that the precaution taken by the injurer is only effective if complemented by precaution taken by the injurer. In this case since the victim takes no care it is likely that the injurer will take less than optimal care.
In the bilateral setting, negligence induces efficient behavior if both injurer and victim are subject to PT. If the injurer is risk neutral it might induce optimal behavior, but not necessarily. Under strict liability, the victim takes no care and the injurer takes a level of care either higher or lower than due care. It seems, therefore, that negligence is superior to liability in both settings.

4.5.2 Activity level. Since the model does not change the residual bearer of risk, the insights of the traditional model regarding the activity level remain valid. It should be noted however that since the perceived benefits of the activity are smaller than the objective one (Biα < Bi), the activity level in general might be smaller than predicted under the traditional model. Some activities of low probability and high magnitude of risk may be abandoned all together.\textsuperscript{135} Moreover, with respect to negligence, when the level of due care under the proposed model is likely to be higher and accordingly the costs of precautions to reach the level of due care are likely to be greater, lower levels of injurer's activity (who is not the residual bearer of risk) might be expected.\textsuperscript{136}

4.5.3 Damages in the proposed model. Although the liability standard in the proposed model incorporates individuals’ perception of risk, the compensations paid under the model are based on objective harm (D=H and not D= λHβ). In other words the compensations paid to the victim in the proposed model do not reflect individuals’ perception of risk.\textsuperscript{137}

This wedge between the compensations paid to the victim and the calculation of damages for the purpose of determining the liability standard has several reasons. First,

\textsuperscript{135} For analysis of activity level problem with diminishing utility See Shavell, supra note 70 at, Ch. 2, 10-7
\textsuperscript{136} For a Graphical representation see Graph 3.
\textsuperscript{137} D = H and not D = λHβ.
contrary to the liability standard, the concept of compensation seems to suggest an ex-post approach.\textsuperscript{138} Thus, for example, under a corrective justice theory, compensations should reflect the actual welfare loss to the victim as a result of the accident, i.e., an ex-post perspective.\textsuperscript{139} As was mentioned in part 3.2, when an ex-post approach is justified PT should not be taken into account and an objective valuation is to be preferred.

Second, setting compensations equal to objective harm is necessary to achieve efficient behavior. Consider first a unilateral setting where the injurer is subject to PT perception of risk. The model predicts that, under a regime of negligence, the injurer will take an efficient amount of precaution. Changing the compensation to reflect the subjective perception of damage will therefore cause him to take an inefficient amount of care. The reason for the inefficiency is that, if compensations reflect subjective perception of harm (i.e., if \( D = \lambda H^\beta \)), the subjective perception will be accounted for twice. In that case, the injurer will face the utility function: \( U_i = B_i - x - W(P(x))\lambda(\lambda H^\beta)\beta \), while, as the model shows, the utility function that leads to efficient behavior is: \( U_i = B_i - x - W(P(x))\lambda H^\beta \).

Even when considering injurers not subject to PT perception of risk, setting damages equal to perceived harm will not incentivize a more optimal amount of care. This is understandable since the perception of the harm is only one part in describing individuals' attitude towards risk, the other being perception of probabilities.\textsuperscript{140} The perception of harm (i.e., the value function) and the perception of probabilities (i.e., the weighing function) may have opposite effects on the overall marginal benefit. For example, as discussed in part 4.3, with respect to accidents of low probability and large magnitude of harm, the subjective

\textsuperscript{138} See Adler & Posner, supra note 52.
\textsuperscript{139} See Sunstein, supra note 52, at 160-3.
\textsuperscript{140} For example, in the unilateral model, setting \( D = \lambda H^\beta \) will lead to the injurer utility function for \( x < x^\wedge \) to be \( B_i - x - P(x)\lambda H^\beta \), unlike the social welfare function which is \( B_i - x - P(x)\lambda H^\beta \). This may eventually lead to an inefficient amount of precaution.
perception of probabilities increases the benefit \(W(P(x)>P(x))\), while the perception of harm decreases it \((H>\lambda H^0)\). Therefore, causing an injurer not subject to PT to internalize only the value function is not likely to incentivize him to take an optimal amount of precaution, but rather to move him farther away from efficient behavior. Efficiency requires therefore that damages will equal actual harm and not perceived one.

4.6 Study Cases. The practical effects of the proposed model can be further studied by the use of study cases.

*The Ford Pinto Case.* The Pinto case vividly represents some of the problems of the traditional model mentioned before. In the early 70s, Ford’s crash tests showed that the fuel tank in its newly designed Ford Pinto car had an explosive potential in rear end collisions.\(^{141}\) Ford estimated that fixing the fuel system will cost approximately $11 per vehicle.\(^{142}\) Given that, by that time, 12.5 Million vehicles were already produced, the total costs were estimated at $137.5M. Ford further estimated that fixing the fuel system will prevent 180 deaths valued at $200,000 each, 180 injuries valued at $70,000 each and 2100 burned vehicles valued at $700 each.\(^{143}\) In other words, Ford estimated the per-car probability of accident, due to the faulty fuel system, as .01968%\(^{144}\) and the weighted average magnitude of harm as $20,354. The expected harm of the fuel system was therefore, approximately $4. Ford argued that, since the cost of precautions ($11 per car) was almost two and a half times greater than the expected benefit ($4), it should be found not liable. This significant difference between the cost of precautions and the expected benefits also implies that even if Ford had some mistakes in its estimations, the final outcome of the

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\(^{141}\) See the Ford Pinto case, at 775. For a description see Leggett, supra note 32.

\(^{142}\) See the Ford Pinto case, at 776.

\(^{143}\) See Leggett, supra note 32.

\(^{144}\) By dividing the overall number of accidents (2,460) by the overall number of vehicles (12,500,000).
economic analysis should not be affected. Despite these evidences, the jury found the company liable of negligence. The California court of appeals then denied Ford's appeal, citing the consumer expectation test as a proper foundation for the jury’s decision.\textsuperscript{145}

The proposed model not only offers support to the court's decision, it further offers a clear standard of liability for future cases. Given the evidence presented by Ford, the perceived cost of precaution under the model is: $\lambda_{11}^B = \$18.56$ and the perceived marginal benefit equals: $W(0.01968\%)\lambda_{20,354}^B = \$75.7$. According to this analysis, the expected harm is four times greater than the costs of precaution. \textit{Ceteris Paribus}, under the proposed model Ford would have been found liable as long as the cost of precaution would have been less than $\$54.5$.\textsuperscript{146}

These results are a complete reversal to those of the traditional model. The striking difference between the two models may be seen as an explanation for the decisions of the court and its rejection of the Hand formula. Moreover, the above results, I believe, demonstrates the proposed model's ability to better reflect people’s preferences and through that, achieving a more welfare maximizing standard of care. Furthermore, unlike the consumer expectation test, the proposed model further provides certainty regarding the scope of due care.\textsuperscript{147}

\textit{The” Swimming Hole” Cases}. Two cases of similar circumstances are \textit{Hendrix v. Peabody Coal Company}\textsuperscript{148} and \textit{United Zinc \& Chemicals Co. v. Britt}.\textsuperscript{149} In Hendrix, a strip mining site abandoned by the defendent was filled with rain water and became a popular recreational destination. Although employees of Peabody (defendant) patrolled the area,

\textsuperscript{145} See Leggett, supra note 32, at 800. For a discussion on the consumer expectation test see part 5.4.
\textsuperscript{146} Since $\lambda_{54.5}^B = \$75.9$.
\textsuperscript{147} See discussion in part 5.4.
\textsuperscript{148} 115 Ill.App.2d 35, 253 N.E.2d 56 (Hereinafter: “Hendrix”).
\textsuperscript{149} 258 U.S. 268. (Hereinafter: “Britt”).
families from "as far away as Chicago"\textsuperscript{150} came to swim and picnic in the "artificial lake". Six years after it was abandoned Hendrix (plaintiff), a 16 years old boy, broke his neck when his head hit the bottom of the lake after he attempted diving into it. From the evidence, it was estimated that the cost of constructing a fence to prevent the accident was approximately $13,000, the harm to the plaintiff was $200,000 and the probability of the accident, given the popularity of the site, was relatively high.\textsuperscript{151}

In Britt, United Zinc (defendant) tore down its chemical factory but left the basement intact. The basement was then filled with rain water which then mixed with the chemical remains of the factory. The presence of chemicals was unobservable and the water remained clear in their presence.\textsuperscript{152} Unlike in Hendrix, the water hole remained unknown to people until, six years later, Britt and another boy went swimming in it and soon after died from poisoning. The court denied defendant liability, basing its decision on the low probability of accident, being that the swimming hole was unfamiliar.\textsuperscript{153}

The two cases are often cited together as a successful application of the traditional model.\textsuperscript{154} However, the similarities between the cases may give reason to pose. Both cases involve severe or fatal injuries, inflicted to young boys, when they were swimming in water holes located in private property. Most importantly, both incidents occurred approximately six years after the abandonments of the property by its owner. Although generalization from a few cases should be done with caution, the large similarities between the cases and the near identity in the time line may put in doubt the justification for the striking differences in

\begin{footnotes}
\textsuperscript{150} Hendrix, at 36.
\textsuperscript{152} See Britt. For discussion see Landers & Posner, supra note 151.
\textsuperscript{153} Id.
\textsuperscript{154} Id.
\end{footnotes}
the standards of care determined by the court. While in Hendrix the traditional model called for precautions in an amount exceeding $13,000\textsuperscript{155} in Britt the amount was closer to $0.\textsuperscript{156}

Under the proposed model the standard of care in Hendrix will remain higher than in Britt. However, applying the proposed model will make the gap less salient. The reason is that the low probability in Britt is subjectively perceived as much greater then it objectively is, while the relatively high probability in Hendrix may be perceived as either slightly higher or even smaller then it objectively is.\textsuperscript{157} The difference in the expected harm between the two cases will therefore decrease and the standard of care will be more similar. As abovementioned, a more similar standard of care might well be justified in light of the many resemblances between the two cases.

5. Implication and Potential Critic.

5.1 Over Insurance. It is well accepted that providing insurance through the liability system is inefficient.\textsuperscript{158} One might argue that the shift in the liability standard proposed by the model and will result in extending the amount of insurance provided through the legal system and is therefore undesirable. However, a closer look at the results of the proposed model reveals a different picture. Mainly, the direction in which the proposed model shifts the level of due care is ambiguous. The model does not necessarily increase the level of due care and, for example, the level of due care regarding accidents with high probability will usually be lower compared to the traditional model. Without a thorough statistical analysis of accidents types, the model cannot be said to unequivocally increase or decrease the level

\textsuperscript{155} Given that the defendant already bore the costs of patrols and was required to bare additional costs of the fence.
\textsuperscript{156} The court decision mentioned no precautions taken by defendant.
\textsuperscript{157} This depends on whether the objective probability crossed the threshold above which the perceived probability is lower than the objective one.
\textsuperscript{158} See Posner, supra note 52; Shavell, supra note 70. at Ch. 6, P.2.
of due care. The model therefore cannot be said to increase the amount of insurance provided by the liability system, rather it adjust the levels of due care for different activities to better reflect the preferences of the parties. These adjustments could either increase or decrease the amount of precaution required to meet the liability standard. If the assumptions regarding subjective welfare and preferences are correct, it is not more insurance, but better insurance the model provides.

5.2 Paternalism. A more general critic might be that the model is paternalistic. A paternalistic rule is one that aims to protect a person against his own free will. It therefore assumes that people will be better off if they were forced to follow the decisions of others. Regarding the model, a critic based on paternalism can be as follows: Instead of having a rule that aims at maximizing objective welfare, allowing the market to sort individual preferences, the model imposes a level of care that it considers to be better for the benefit of individuals.

To answer this critic, one should consider its implicit assumption - that the current liability rule is not paternalistic. This assumption however seems to be false. Just as the proposed model imposes a liability standard on individuals so does the traditional model. The fact that the Hand formula aims to maximize objective welfare does not diminish the fact that it imposes this decision on others, nor does it transforms the traditional model into a ‘neutral’ rule. Moreover, if one accepts the proposed model as better depicting individuals’ preferences then, it could be argued, it has far less paternalistic properties than the Hand formula. The reason being, that although both models impose rules in order to maximize

individuals' welfare, the proposed model better reflects the choices people would have made on their own.

It should be noted that this argument also stands when the possibility of bargaining is considered. To the extent that any form of direct or indirect bargaining is feasible, both rules allow parties to contract around them. Under these circumstances, if the proposed model is more suitable to individual's preferences it will bring less need for bargaining and therefore may reduce transaction costs.

5.3 Efficiency of Warnings. The issue of warnings has long been debated in tort literature. In general, the idea of warnings assumes that if a person is fairly warned, his legal remedies in the event of a subsequent accident should be limited or none at all. The concept of warnings closely relates to the one of subjective attitude towards risk. After being fairly warned, the victim has the ability to decide on his actions according to his subjective perception. It could be argued then, that when warnings are applicable there is no longer any need to consider individual's perception of risk in the standard of liability. Rather, it is enough to require adequate warnings and let the market reveal subjective preferences. In other words, a requirement to warn might be seen as an alternative to the proposed model for revealing subjective preferences, one that allows the liability standard to be based on the traditional approach.

The main objection to the idea of warnings as an alternative solution lays in the assumption that warnings provide accurate knowledge about the risk. As discussed in part

161 See e.g., Viscusi, supra note 160, at 605.
3.2 many psychological mechanism influence people's decisions. However, unlike PT, mechanisms like heuristics and biases do not represent genuine preferences. With respect to warning, it is commonly argued that the effect of such mechanisms on the decision making process prevent warnings from effectively conveying the objective risk of products and activities. Moreover, even if information on objective risk is known, bounded rationality often prevent people from fully understanding it. Without accurate knowledge of the risk and the ability to process it, it can no longer be argued that after being warned, people’s decisions would reflect their genuine preferences. This was clearly noted by Slovic:

“a revealed preference approach assumes that people not only have full information, but also can use that information optimally, an assumption that seems quite doubtful in the light of much research on the psychology of decision making”.

Not only do cognitive mistakes distort people’s understanding of ‘well intentioned’ warnings, but manufacturers aware of these effects often use them to their advantage. By having sole discretion on how warnings are articulated, manufacturers are able to display ‘accurate’ warnings in a way that prevents real appreciation of risk by potential victims. Moreover, through the use of advertising and other forms of communication, manufacturers are able to ‘undo’ most of the remaining effect of warning and create a perception of safer

162 See part 3.2.
163 See e.g., Jolls, Sunstein & Thaler, supra note 102; Guthrie, supra note 37, at 1133; Slovic, supra note 38, at 82, 166; Kysar, supra note 33;
164 Slovic, supra note 38, at 82.
165 Id.
166 Jolls, Sunstein & Thaler, supra note 102, at 1533, argued that: “Provide more information’ says nothing about the way in which the information will be provided, and yet we [...] that this will matter a great deal [...] The actors subject to the mandate will often have an interest in providing the least scary, most pallid version of the information possible”, see also Henderson, A. J. Jr., & Rachlinski, J. J., ‘Product-Related Risk and Cognitive Biases: The Shortcomings of Enterprise Liability’, 6 Roger Williams U. L. Rev. 213.
167 Kysar, supra note 33, at 1752.
products. These ideas also took hold in the judicial system: “a modern manufacturer [...] not only processes [its product] and dresses it up so as to make it appear appetizing, but he uses the newspapers, magazines, billboards, and the radio to build up the psychology to buy and consume his products.” Although calls are sometimes made to change regulations in order to provide more informative warnings, the ability to achieve effective warnings through regulation is very much at doubt.

In light of the above, it seems unlikely that warnings can be used to bring to light subjective preferences. Powerful psychological effects often prevent any useful information from being conveyed and bounded rationality makes it less likely that people will be able to process the information available. If maximizing subjective welfare is the goal then, according to the literature, it seems that it is a goal that warnings fail to accomplish. In that respect, warnings cannot be seen as an alternative to the proposed model.

5.4 Assumption of Risk. Although the issue of warnings and the doctrine of assumption of risk often go hand in hand, assumption of risk remains an independent doctrine. According to the doctrine, a person who decided to participate in a certain activity, despite being aware of its risks, is barred from claiming subsequent damages. The doctrine of assumption of risk is largely justified in law and economics literature. Unlike warnings, the assumption of risk doctrine often goes in the same lines of the proposed

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168 As was argued by Guthrie “product manufacturers use advertising, promotions, and price setting to shape consumer perceptions and thereby induce them to underestimate product risks.” Guthrie, supra note 37, at 113; Kysar, supra note 33, at 1748-52, stated that the idea of manufactures manipulating was presented by Prof. Chamberlin as early as 1920.
170 See Kysar, supra note 33, at 1749.
171 See e.g., Slovic, supra note 38, at 166.
172 In the sense that, when a person is dully warned he can be viewed as assuming the risk.
174 Id.
model. For example, the defense usually requires that the plaintiff had ex-ante sufficient and accurate information of the risk.\textsuperscript{175} In this respect, it seems to require a true revelation of the consumer's preferences and is more similar to the idea of contractual bargaining.\textsuperscript{176} In other words, both the doctrine and the proposed model give precedent to subjective perspective and preferences.

A second implication of the proposed model, with respect to assumption of risk doctrine, relates to the nature of risk itself. Because of the requirement that the plaintiff had ex-ante sufficient knowledge, the defense of assumption of risk is likely to be used when the activity or product posse a risk of relatively high probability, i.e., activities or products that are risky in their nature. Similarly, under the proposed model, risk of high probability yields a lower standard of liability then under the traditional model.\textsuperscript{177} There is, therefore, a certain correlation between the defense of assumption of risk and the level of due care under the proposed model. Although this correlation might be coincidental, it may also be that the same psychological ideas are at the basis of the two.

5.5 Doctrinal Applications – Consumer Expectations. Although PT may appear to some as a complicated mathematical theory, the phenomena it describes spontaneously effects people in their every decision. Being ever present in the decision making process, it will not be surprising to find some of its basic ideas already present in current legal doctrines.\textsuperscript{178} The next section explores the legal doctrine of ‘consumers’ expectations’ that could be considered as implicitly incorporating some of the insights of PT.

\textsuperscript{175} See Note, 'Assumption of Risk and Strict Products Liability’, 95 Harv. L. Rev. 872 (1982), at 873-881.
\textsuperscript{176} Id, at 875.
\textsuperscript{177} See discussion in part 4.3
\textsuperscript{178} Hayden & Ellis, supra 73, at 653 claimed that behavioral ideas have a ‘common sense notion’ and therefore affect the legal system.
The consumer expectation test was developed by courts in order to include consumers' preferences, perspectives and beliefs in the liability standard. It was to be an alternative to the risk-utility test\(^\text{179}\) for product liability, which was considered by the court as a test that "fails to capture the full spectrum of concerns relevant to product liability law".\(^\text{180}\) Rather than focusing on costs to the manufacturer, the consumer expectation test focuses on the victims and aims to adopt their preferences and attitude towards risk into the liability standard. In that respect, it seems, the test aims to achieve similar goals as the proposed model – maximizing utility by adherence to people’s attitude towards risk. The consumer expectation test requires the judge (or jury) to first determine the level of safety an ordinary consumer would expect and then to decide whether such level of safety was provided by the manufacturer.\(^\text{181}\) In that way, it is believed, the interest of potential victim (i.e., consumers) is be better served than it is by the market place.\(^\text{182}\)

Despite its appeal, the consumer expectation test has its shortcomings. First, consumers lack sufficient knowledge to adjust their expectation to changes in technology and possible alternative designs.\(^\text{183}\) As was noted in *Baker v. Lull Engineering*, the test “treats such consumer expectations as a ceiling on a manufacturer’s responsibility”.\(^\text{184}\) Advance in technology therefore would not raise the standard of liability, despite the fact that it would be efficient to do so. The second major problem is based on consumers' susceptibility to manipulation. As previously discussed with respect to warnings, manufacturers are able to manipulate consumers' perception of the risk embedded in their

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\(^\text{179}\) The risk-utility test is similar to the negligence test, with some distinct features. For comparison see Viscusi, supra note 160, at 598.

\(^\text{180}\) Kysar, supra note 33, at 1704.

\(^\text{181}\) Id.

\(^\text{182}\) Id, at 1745.

\(^\text{183}\) Id, at 1716.

\(^\text{184}\) 573 P.2d 443 (Cal. 1978). The Baker court then determined that a breach of either consumer expectation or the utility-risk test is sufficient to find the defendant liable. See Kysar, supra note 33.
products and influence the very expectations the test is meant to examine.185 Given these manipulations, the expectations of consumers seem less ideal in revealing consumers' genuine preferences and concerns. Moreover, not only manipulations influence consumers' expectation. Psychological effects such as heuristics and biases also threaten to distort preferences and perceptions. 186 As was discussed in Part 3.2, these effects are not considered to depict genuine preferences and are usually thought of as the result of bounded rationality and lack of information. Just as manufacturers’ manipulation effect people's perceptions, heuristics and biases too threaten to render the consumer expectation test irrelevant in revealing what consumers are truly concerned about.

The proposed model has similar goals to those of the consumer expectation test. However, it also provides solutions to many of its problems. On the one hand, like the test, the model incorporates individuals' perceptions and attitude towards risk. On the other hand, it distinguishes such preferences from psychological phenomena such as heuristics, biases and manipulations present in the market place. To put in a consumer expectation language, the model asks not what the ordinary consumer actually expects, but rather what would have been the expectations of an ordinary consumer should he have full information and no cognitive limitations. In doing so the proposed model also removes any limitations posed by consumers’ actual knowledge regarding technological developments and alternative design options. Therefore, the proposed model is better able to adjust the liability standard in light of technology advances. Moreover, the proposed model offers a higher degree of legal certainty to manufacturers. Under the model, manufactures no longer have to speculate what will courts' determine as the consumers' safety expectations regarding their products. In that

185 Kysar, supra note 33, at 1753.
186 Id, at 1773.
sense, I believe, the proposed model strikes a more reasonable balance between market forces on the one side and the desires and preferences of consumers on the other. The proposed model is thus better suited to settle the differences between consumer protectionists and market enthusiasts.


6.1 An “As if” interpretation.187 When discussing the practical use of the traditional model, Shavell noted that he does not expect individuals or courts to conduct mathematical calculations of marginal costs and benefits.188 The practical use of the theory, he argued, is a much more natural one, where only the general notion of the benefits and costs of precautions are to be compared without engaging in the actual mathematical calculations.189

Although the mathematical representation of the proposed model may seem complicated compared to the traditional model, its usage under the "as if" interpretation is just as easily applied. The main difference is that under the proposed model, benefits and costs are not compared ‘as is’, but instead the comparison is made while considering people’s attitude and subjective preferences regarding risk. The simplest way to do so is by keeping in mind the fourfold pattern. Thus, if probability of accident is low and the magnitude of harm is large, courts should set a higher standard of liability in comparison to the one under the traditional model. If the magnitude of harm is low and probability of an accident is high, the level of care should be lower.

It should be noted however, that if one still desires to make an accurate calculation of costs, probabilities and harm the current model impose no additional hardship. The fact

187 The term was used by Shavell, supra note 70, at Ch. 2, 10
188 Id, at Ch. 2, 10-11.
189 Id, at Ch. 2, 10-11.
finding requirement for the proposed model are identical to those of the traditional model and while the mathematical equation might be a bit more complicated, in this age of calculators and computers it should not be considered to require any additional, significant effort.

6.2 Different theories on perception of risk. PT is a well accepted theory of decision making under uncertainty. That said, many other well known theories exist, each providing empirical and theoretical support for their findings. The findings of these theories however, may not be as diverse as it may seem at first glance. Many theories provide for a similar account of subjective perceptions of risk as PT and are generally in agreement with the fourfold pattern suggested by PT.191

Considering the ‘as if’ approach mentioned above, the existence of different theories should not amount to a substantive limitation to the practical use of the model, as long as the overall direction of the different effects remains in agreement. In a more theoretical perspective, advances in the field of decision making may require changes and adjustments to the formal model. It should be noted however that even if differences of opinions exist, the proposed model is still likely to provide a better description of people’s preferences and perceptions compared to the traditional approach. Thus, ultimately, its usage in the liability standard could increase overall welfare.

6.3 Sub-Classes. An issue not in the scope of the thesis is that of sub-classes of injurers and victims. Sub classes are well developed in tort law and include categories such as professionals, children and mentally disabled persons.192 In economic terms sub classes

190 For a discussion see Teitelbaum, supra note 46; Edie, supra note 36; Bigus, supra note 44.
191 Edie, supra note 36.
192 See e.g., Van Dam, supra note 31, at 812-815.
may refer, for example, to groups with costs function substantially different than those of the reasonable person. The idea of groups having unique characteristics is of much relevance to the incorporation of perception of risk into the standard of liability. For example, an important sub class can be accidents in which injurers and victims are usually risk neutral. In these setting, the traditional model better depict the parties' preferences and is superior to the proposed model. Maximizing social welfare therefore requires identifying the relevant sub classes and choosing the rule that most suits them. An important word of caution is however required. The sub-classes should consist of a large enough population to justify the administrative, litigation and other additional costs they create by deviating from the general rule of liability.

7. Conclusion.

To conclude this thesis it may be best to view it as an attempt to combine the emerging field of behavioral law and economics with the well founded economic analysis of accidents. To reach this objective the thesis aimed to achieve three goals. First, it intended to justify the use of subjective perception of risk in the measurement of utility. To do so Part III provided several distinct arguments, each of them sufficient to consider PT as having normative implications. Second, the model developed in part IV provided an initial formal analysis of the effect of the new measurement of utility on the optimal amount of precaution and the standard of care. The two main insights of the formal analysis are the superiority of negligence over strict liability in both unilateral and bilateral settings and the model’s predications that people are likely to choose the optimal level of care.

193 For example, the cost function of children may be much steeper than that of the average adult person.
The thesis then discussed the wider implications of the proposed model. Most interesting is the connection between the ideas present in the proposed model and the consumer expectation test. This correlation, I believe, provides some evidence that the use of psychological insight is not merely a theoretical curiosity, but a growing desire of the legal practice. This desire provides further motivation for theoretical and formal inquires in the behavioral analysis of the law, as this thesis tried to achieve.

Additional research, both empirical and theoretical is much required. Advances in the ability to predict the natural framing of outcomes, additional justifications for the use of subjective perspective in the measurement of utility and the identification of sub classes, such as regulators and major corporations,\footnote{These are two examples of agents which are more likely to be risk neutral and therefore different assumption regarding perception of risk may be required in order to maximize social welfare.} are just a few examples for the future research to be done.
ANNEX 1: GRAPHICAL REPRESENTATION OF PROPOSED MODEL (ALTERNATIVE FRAME).

Social Welfare of the Proposed and Traditional Models under Alternative Framing

![Graph showing social welfare comparison]

Expected Harm of the Proposed and Traditional Models under Alternative Framing

![Graph showing expected harm comparison]
The Graphs above are the presentation of the data below. Note: \( H = 400,000; \ Bi = 10,000; \)

\[ P(x) = \frac{1}{x}. \] The values of \( X \) are provided in intervals of 20.

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ANNEX II: DATA FOR GRAPHS 3 & 4.

The information was used to construct the table below. Note: $H = 400,000$; $Bi = 10,000$;

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