Behavioral Models in Tort Law

Abstract: In this paper, we illustrate how different behavioral problems can be incorporated into the standard economic model of tort law. Through this exercise, we develop a modeling language that can be utilized by law and economic scholars when considering the effect of behavioral biases and cognitive imperfections in tort law. We use these models in conjunction with the standard taxonomy of psychological biases, to show the effect of different biases on the behavior of tort agents. The models we present are applicable to a wide range of tort problems, and have the potential for application to a broader range of legal problems.

JEL Codes: K13, K43, D03, D81
Keywords: Behavioral biases, social biases, memory biases, tort law

1. Introduction

Legal rules create incentives expecting that people will rationally respond to legal sanctions and institutional constraints. However, biases and imperfections in human cognition alter people’s response to legal incentives, undermining the effectiveness of legal intervention (Sunstein, 2000; Parisi and Smith, 2005). A number of psychological biases alter people’s assessment of their own skills and of the risks they face, jeopardizing their ability to act optimally in their daily activities. As pointed out by a number of scholars, behavioral biases and cognitive imperfections pose a distinctive problem in the design of tort rules (Posner, 2003; Grady, 2005; Jolls, 2005; Ulen, 2005). As such, tort law may fail to deter certain activities because the human response to these rules may be hindered by the same biases and cognitive shortcomings that affect the tortious behavior.
This paper examines how problems identified by behavioral literature become relevant in the face of a tort action. Section 2 considers the existing taxonomy of behavioral problems and suggests how such problems could be modeled in the context of a tort problem. This exercise aims to provide a common modeling language that can be utilized by law and economic scholars when considering the effect of behavioral biases and cognitive imperfections in tort and other areas of law. Through this exercise we intend to show how different behavioral problems can be incorporated into the standard tort model and expressed in algebraic form. Our formulation is one demonstration of the many possible expressions of behavioral problems and tort action concepts. The models we present are applicable to a wide range of tort law and have the potential for application to a broad range of legal problems. Given the limited scope of this paper, Section 2 derives only basic results based on our formulations through comparison of simple first-order conditions of the standard tort problem. Section 3 discusses instruments useful in determining the extent to which debiasing and insulating strategies can be employed in tort policy.

2. Modeling Behavioral Biases and Cognitive Imperfections in Tort Law

The social sciences utilize a stylized model of human choice that provides an operational set of working hypotheses and conjectures. Over time, many of these hypotheses and conjectures crystallize and advance in status to self-evident axioms of human choice, providing a set of operational rules in the analytical toolbox of the field or discipline. Economic analysis, for example, starts from a set of fundamental rules regarding human choice. It includes a description of how human beings value their actions, how they perceive the environment in which they act, how they gather and process information regarding themselves and others, and how they choose to act to satisfy their objectives. The standard operational assumption widely adopted by economic theory is the so-called “rational actor” model, a stylized view of human choice within which the “economic man” is able to perfectly process information and choose the action that maximizes his objectives. Despite the social sciences’ ability to develop a set of operation rules, this does not necessarily guarantee their accuracy. Over the past
twenty years, research at the intersection of economics and psychology has revealed the inadequacy and predictive shortcomings of the economic assumption of rationality. Behavioral and experimental economics research has shown the behavioral regularities of real human beings depart from the behavioral patterns of the “economic man” acting within the paradigms of economic rational choice.

The attempt to open the “black box” of human reasoning and adopt a description of human behavior more aligned with reality is especially important to the fields of law and applied economics. These fields derive policy implications from economic models in order to assess the efficiency of legal rules and institutions. In carrying out this task, law and economics relies on a description of human behavior to assess how individuals react to changes in law or legal institutions. Behavioral law and economics contributes to this task by utilizing the findings of psychological and behavioral decision research. The resulting, empirically based, models of human behavior lend greater accuracy to the analysis of law and legal institutions and deliver more robust policy implications.

2.1 A Simple Tort Model Under Full Rationality

We start our analysis by recasting the standard bilateral care model of tort law, in which both parties are assumed to be fully rational. The full rationality assumption in a tort model implies that both the tortfeasor and the prospective victim correctly assess the riskiness of their actions, the effectiveness of their care, the gravity of the potential loss, and the cost of care. Parties in the standard tort model are thus assumed to be free from the behavioral biases that affect ordinary humans. Understanding the structure of the tort problem under full rationality serves as a stepping-stone for understanding the tort problem when behavioral problems are introduced. Based on the requirements of the standard bilateral care model, we consider below a general full-rationality setting under which we model the enforcement and settlement opportunities for the tortfeasor and the victim.

The tortfeasor carries out an activity, denoted by $w$, which generates a value $V_T(w)$ to the tortfeasor. Similarly, the victim carries out an activity, denoted by $z$, which produces a value $V_T(z)$ to the victim. The activities $V_T(w)$ and $V_T(z)$ share similar properties; the
value of the activity $V_V(z)$ increases with the activity level in the relevant range at a decreasing rate, i.e., $V_i > 0$ and $V_{ii} < 0$ for $i = w, z$. Both parties contribute to the likelihood of an accident. Parties can, however, invest in precautions to reduce the probability of an accident. Denote respectively with $x$ and $y$ the tortfeasor’s level of precaution, where $x \in [0, \infty)$ and the victim’s level of precaution, where $y \in [0, \infty)$. Precautions depend positively on activity levels. The probability of an accident decreases proportionally to the tortfeasor’s and/or the victim’s precautions ($x$ and $y$) at a decreasing rate. Analytically, an accident occurs with probability $p(x, y)$, where $p(x, y) \in (0,1)$, $p_i < 0$, $p_{ii} > 0$, for $i = x, y$. In most tort problems, parties’ precautions are assumed to be substitutes, i.e., $p_{xy} < 0$. When an accident occurs, it creates an (exogenous) loss denoted by $L$, where $L > 0$. Total expected harm is equal to $wzp(x, y)L$.\(^1\)

Following Shavell (1987), total welfare is defined as the sum of the value of the activities of the tortfeasor and the victim, and both parties’ net expected accident and precaution costs. Analytically, the social welfare function takes the following form:

$$\max_{(x,y,w,z)} S = V_T(w) + V_V(z) - wzp(x, y)L - x(w) - y(z)$$

The socially optimal levels of precaution $x^{**}$ and $y^{**}$ are defined by the following first order conditions:

$$-wzp_x(x^{**}, y)L = 1 \quad (1)$$
$$-wzp_y(x, y^{**})L = 1 \quad (2)$$

At the social optimum, the marginal reduction in the expected accident loss equals the marginal cost of care.

The socially optimal levels of activity $w^{**}$ and $z^{**}$ satisfy the following first order conditions:

$$V_w = zp(x, y)L \quad (3)$$
$$V_z = wp(x, y)L \quad (4)$$

According to these conditions, the marginal benefit from an increase in activity level equals the marginal cost of the activity, given an increase in expected accident loss.

\(^1\) The multiplicative relationship of the activity levels, $w$ and $z$, in the production of an accident captures the intuition that both tortfeasor and victim need to carry out the activity for the accident to occur.
Social and private incentives may differ. In order to investigate the optimal private incentives of the parties, we must characterize the private problems of the tortfeasor and the victim under alternative liability regimes. Setting the stage for the subsequent analysis, we enrich the model by allowing for imperfect enforcement and/or out-of-court settlement, which may affect precaution and activity incentives. Assume that when an accident occurs, enforcement occurs with probability $e$. Enforcement is perfect when $e = 1$ and imperfect in all those cases when $e < 1$. When an accident occurs and enforcement ensues, parties can sue and the court liquidates damages equal to $D$. However, parties may prefer to opt for an out-of-court settlement solution in which the tortfeasor agrees to pay $S$. Assume the parties litigate with probability $\alpha$ and choose an out-of-court settlement with probability $1 - \alpha$, where $0 < \alpha < 1$.

The tortfeasor’s private objective function takes the following form:

$$\max_{(x,w)} F = V_T(w) - ewzp(x,y)[\alpha D + (1 - \alpha)S] - x(w)$$

The private optimal levels of precaution $x^*$ and activity $w^*$ are defined by the following first-order conditions:

$$-ewzp_x(x,y)[\alpha D + (1 - \alpha)S] = 1 \quad (5)$$
$$V_w = ezp(x,y)[\alpha D + (1 - \alpha)S] \quad (6)$$

The victim’s private objective function takes the following form:

$$\max_{(y,z)} V_L(z) - wzp(x,y)L + ewzp(x,y)[\alpha D + (1 - \alpha)S] - y(z)$$

The private optimal levels of precaution $y^*$ and activity $z^*$ are defined by the following first-order conditions:

$$-wzp_y(x,y^*)[L - e[\alpha D + (1 - \alpha)S]] = 1 \quad (7)$$
$$V_z = wp(x,y)[L - e[\alpha D + (1 - \alpha)S]] \quad (8)$$

In Section 2.2, we build on this setup by considering possible ways to model behavioral departures from full-rationality due to cognitive, behavioral, and social biases. We will demonstrate that these biases can affect the perception of each and every component of a risk-creating activity as well as the perception of enforcement and settlement.
opportunities after the tort occurs. We will use these models to illustrate how such biases may affect the familiar results of efficiency in tort law.

2.2 What About Making it Real?

Behavioral law and economics attempts to bridge the analytical gap between the paradigms of rational choice and the observations of how humans actually choose. The resulting models account for the way in which individuals process information and choose their behavior. We contribute to this literature by developing a tort model that embeds a more complex and realistic description of human decision-making legal analysis. To start, we use the classification of behavioral biases drawn from experimental and psychological evidence. Experimental and psychological research has identified behavioral regularities and cognitive biases that lead to departures from the standard paradigm of rational choice. For example, people tend to adopt simplifying decisional procedures that reduce or completely suppress relevant information. This may stem from individuals false perceptions of the likelihood of events based on their optimistic or pessimistic disposition, lack of knowledge, or inability to accurately process available information. Individuals tend to make decisions not on a “neutral” interpretation of evidence, but rather base their choices on cognitive factors, affecting their ability to correctly process available information. We have identified a handful of biases that affect an individual’s overall decision-making capabilities and beliefs, and list them in Tables 1 and 2. As this list is drawn from the ever-growing number of biases identified by behavioral scientists, it is by necessity tentative and incomplete. In Table 1, we introduce behavioral biases in decision-making.
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In addition to the behavioral biases discussed in Table 1, other biases become relevant in the context of tort law. Some of these biases arise through social interactions with other human beings and cause distortions in self-esteem, self-perception, consensus estimation, and causal attribution. For example, individuals may regard themselves as being more popular than they actually are or think of themselves as better (or worse) at carrying out some activity than the average person. These social biases, listed in Table 2a, substantially affect individual decision-making and should be properly taken into account when analyzing the effectiveness of law. Biases may also be driven by memory errors (listed in Table 2b) affecting an individual’s ability to store information and events in his or her memory, or to retract and correctly process information stored in the memory.
Each of these biases affects the results of the standard model of tort law. In a standard setting, a potential tortfeasor engages in some risky activity. The tortfeasor and a prospective victim may take precautions in order to reduce the probability and/or the gravity of an accident. A behavioral model of tort law should capture the effects of these biases on the parties’ choices in a tort situation. Specifically, we will consider the effect of biases on the parties’ perceptions of the probability of an accident, the severity of the

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**Table 2: Social Biases and Memory Errors**
harmful consequences, or on the parties’ misperception of their individual skill level, to attain a false estimation of the cost or effectiveness of care. In an attempt to capture the complexity of human behavior in a manageable way, the taxonomy of biases in Tables 1 and 2 list the most direct effects of biases on choice. Biases, however, often operate on more than one level, affecting multiple or all variables of the tort problem. Our focus is on the behavioral regularities and biases that appear to undermine the standard design of tort law based on the standard rationality framework. Our effort to model behavioral irregularities and biases will hopefully serve as a first step toward a more complete and effective economic analysis of tort law.

2.2.1 Biases Affecting the Perceived Probability of an Accident

Inside the rational-person paradigm, individuals are able to perfectly assess the objective probability of an event and to infer information correctly from the available evidence. Behavioral and experimental research has shown that people inaccurately estimate the riskiness of their actions and of the environment in which they operate. When individuals underestimate or overestimate the likelihood of events, legal rules may fail to deliver efficient care and activity level incentives. Here, we illustrate how to model biases that affect individuals’ assessment of the riskiness of their actions and/or estimation of the likelihood of events.

As a first example, consider optimism bias. Optimism alters people’s estimates of the likelihood of future events, making them to overestimate the chances of positive or desirable events and underestimate the chances of negative or undesirable events (Colman, 2001).\(^2\) Analytically, an optimistic person systematically underestimates the objective probability of an accident, denoted by \(p(x, y)\). This can be expressed in a tort model by denoting:

\[
p(x, y) < \overline{p(x, y)} \quad \text{for any } (x, y) \quad (9)
\]

\(^2\) See, among others, Lund (1925), Cantril (1938), and Weinstein (1980).
Optimistic individuals distort the probability of an accident perceiving a lower risk, \( p \), than the true risk they face, \( p \). Contrary to intuition, the sole presence of an optimism bias does not distort the marginal incentive to undertake precautions. Hence, the first-order conditions for the tortfeasor and the victim, respectively in (5) and (7), will not change. In the absence of any enforcement error and with perfect damage liquidation, private and social incentives are perfectly aligned in the presence of an optimism bias. The reason why is that the optimism bias introduces a distortion on the perceived level of uncertainty, but not on the effectiveness of care. The optimism bias, however, will cause a suboptimal high level of activity for both the tortfeasor and the victim. The deflated perception of activity riskiness drives each subject to underestimate the expected costs of the activity, thereby increasing the activity level above the social optimal level.

Optimistic individuals may, in some cases, inaccurately estimate the riskiness of an event only for a subset of circumstances. For example, in some situations, individuals tend to disregard risks that are perceived to be very small, such as in the so-called zero-risk bias (Baron, Gowda, Kunreuther, and Howard, 1993). In more extreme cases, individuals act as though uncertainty does not exist and make decisions believing one circumstance is certain and disregard all other possible outcomes of their choice, such as in the neglect probability bias (Redelmeier and Kahneman, 1996).

Posner (2003) analyzed the zero-risk bias as a special form of optimism bias. The individual perceives the probability so that:

\[
 p(x) = \begin{cases} 
 0 & \text{if } p < \overline{p} \\
 p(x) & \text{if } p \geq \overline{p} 
\end{cases} 
\]  

(10)

According to Posner’s (2003) analytical specification, the individual correctly assesses the probability of an accident when the probability is above a given threshold, \( \overline{p} \), but sets accident probabilities to zero when the probability falls below the given threshold. Posner (2003) examined the effectiveness of alternative liability regimes in a unilateral care model. Posner shows that under both strict liability and negligence, individuals employ an inefficient level of care – too much or too little – for sufficiently high levels of probabilities, falling above the threshold values of zero-risk bias, and employ optimal care for intermediate values. Posner additionally shows the tendency for
the difference in probability level assessment on activity levels between strict liability and negligence to disappear in these cases, due to the fact that the optimistic agent treats rare events as zero-probability events.

Beliefs regarding event likelihood may be distorted downward as well as upward. This occurs when individuals are affected by a pessimism bias or a moral pessimism bias (Alloy and Ahrens, 1987). People affected by a pessimism bias tend to overestimate the likelihood of negative events and perceive the environment to be riskier than it actually is. Moral pessimism bias entails a negative expectation of the moral attitude of other individuals in society and the expectation that others violate legal and social norms more frequently than is actually observed.

Analytically, a pessimistic person systematically overestimates the objective probability of an accident, throughout the range of probability values. In a tort law setting, this can be modeled as a shifted probability function, as follows:

\[ \bar{p}(x, y) > p(x, y) \text{ for any } (x, y) \quad (11) \]

A pessimism bias operates symmetrically to the optimism bias. The private marginal incentive to undertake care is not necessarily distorted and first-order conditions for the tortfeasor and the victim will coincide respectively with (5) and (7). However, the pessimism bias, resulting in an inflated perception of the activity riskiness, drives the parties to decrease their activity level below the socially efficient one, other things being equal.

Individuals may also face decisions under uncertainty, when information on alternative outcomes may be missing or ambiguous. Ellsberg (1961) identified the ambiguity effect, which describes how people tend to choose outcomes with known probability over those outcomes with unknown probability. The ambiguity effect may thus shift accident probability either downward or upward. This result can be explained by the psychological tendency to include only those options for which information is available in the strategy set (see Frisch and Baron, 1988).

Teitelbaum (2007) models ambiguity using Choquet’s (1954) expected utility model and examines optimal care and activity incentives in a unilateral tort setting. According to Teitelbaum (2007), the tortfeasor’s optimal care decreases with ambiguity if she is ambiguity-loving, or increases if she is ambiguity-averse. Negligence based rules appear
more robust to ambiguity and may therefore be superior to strict liability in unilateral accident cases.\footnote{For analysis of the impact of legal ambiguity in tort law, see also Geistfeld (2011) and Chakravarty and Kelsey, (2012).}

When faced with a decision, individuals tend to adopt decisional procedures called \textit{heuristics} to simplify the decision-making process (Kahneman, Slovic and Tversky (1982)). The adoption of a decisional heuristic allows a person to save time when processing information or to reduce the amount of calculations required by reducing the information set. Psychological studies show that individuals tend to adopt the anchoring heuristic, which is an assessment of the subjective estimation of the likelihood of a specific event, by focusing on a single piece of available information and over-relying (anchoring) on that sole piece of information. The anchoring heuristic produces biased estimations of the likelihood of an event toward the anchor value (see Epley and Gilovich, 2001, discussing the tendency of anchoring with insufficient adjustment). This bias may be either upward or downward, depending on the anchor value chosen. Analytically, a person adopting an anchoring heuristic will estimate the probability of an event in the following way:

\[ p^A(x, y) = a + T(x, y) \] (12)

where \( a \) indicates the anchor value and \( T(x, y) \) is the adjustment of the anchoring value, which may be either negative or positive. It follows that the estimated likelihood of an event may be either greater or less than the objective probability of that event, i.e.,

\[ p^A(x, y) \geq p(x, y) \] (13)

The anchoring heuristic will not affect the marginal incentives to undertake precaution, and first-order conditions for the parties will coincide with equation (5) for the tortfeasor and (7) for the victim. However, the direction of the distortion induced by the anchor will affect the perceived riskiness of the activity, thereby causing the parties to engage a suboptimally low or high level of activity.\footnote{The anchor value may be suggested by a counterparty when signing a contract (for example, when an insurance company allows the customer to self-select a contract type), or may be part of a training program to reduce accident mortality (for example, in the workplace or for automobile drivers). The law may affect the choice of the anchor, thereby reducing the inefficient activity level chosen by parties.}
Similar effects are generated by a number of other behavioral patterns identified by psychological research. An availability bias occurs when an individual estimates the likelihood of an event on how easily he recalls that specific event. (Tversky and Kahneman (1974), Reyes, Thompson and Bower (1980), Johnson and Tversky (1983)) The availability bias produces estimations skewed toward more vivid events stored in the memory, events that appeared frequently in the media, or unusual or sensational events, which are easier to recall. For this reason, people tend to think that traveling by airplane is riskier than traveling by car, even though the death rate for car accidents is actually higher. Similarly, a primacy or recency bias (Nickerson, 1998) produces a skewed estimation of the likelihood of an event toward more recent events or those with a higher emotional impact. Overestimation or underestimation of the accident likelihood may be caused by the inability of the individual to estimate correctly the impact of the prior probability of an event when assessing its conditional probability. This is the so-called base-rate fallacy (Nisbett, Borgida, Crandall and Reed (1976), Kahneman and Tversky (1982)). Similarly, the conjunction fallacy (Tversky and Kahneman, 1983) occurs when the probability of a conjunct event is assessed as higher than the likelihood of the single events.

2.2.2 Biases Affecting the Effectiveness of Care

Behavioral biases do not only affect the perception of riskiness but may also influence individual perception of one’s own abilities and comparison of oneself with other individuals in society. In a tort setting, a distortion in perceived personal ability may affect the effectiveness of care. Individuals invest in precautions and are required to think about how much each unit of care will reduce accident probability. More skilled individuals will achieve the same reduction in accident probability by investing less units of care. A distorted perception of individual ability compared to the rest of society may therefore introduce inefficiency in care incentives. In this section, we discuss several behavioral biases and investigate how we can model such distortions.
Individuals tend to display “positive illusions,” i.e., they may hold “unrealistically favorable perceptions about themselves” (Taylor and Brown, 1988). Positive illusions include, among other biases, the above-average effect and the illusion of control bias.\(^5\)

The above-average effect (also known as the “illusory superiority bias” or “placement bias”) is a cognitive social bias that leads people to overestimate their positive qualities and underestimate their defects. (Alicke, Dunning and Krueger, 2005) Evidence of the above-average effect is quite robust with respect to common abilities and tasks (e.g., driving, parenting, managerial skills) but weaker with respect to unusual tasks.

The illusion of control bias (Langer (1975), Langer and Roth (1975)) identifies situations where an individual believes she is able to influence the realization of a desirable positive outcome, or avoid an undesirable negative outcome, even if she has no real ability to control the final outcome of her actions.

Both the above-average effect and the illusion of control biases have great relevance in legal analysis, especially in a tort context. Positive illusion biases produce an inflated perception of the effectiveness of one’s care. In the presence of an illusion bias, denote with \(\bar{p}\) the subjective probability of an accident and with \(\bar{p}_i = \frac{\partial \bar{p}}{\partial i}, i = x, y\), the distorted marginal effectiveness of care for the tortfeasor and the victim. As suggested by Parisi (2013), even if based on different psychological explanations, these biases can be modeled in the following way:

\[
|\bar{p}_i| > |p_i|, i = x, y \quad (14)
\]

In the presence of positive illusions, individuals perceive their care as more effective than it actually is. The first-order conditions for the tortfeasor and the victim will become respectively:

\[
-ewz\bar{p}_x(x, y)[\alpha D + (1 - \alpha)S] = 1 \quad (15)
\]

\[
-wz\bar{p}_y(x, y^\ast)[l - e[\alpha D + (1 - \alpha)S]] = 1 \quad (16)
\]

\(^5\) Positive illusions include also unrealistic optimism (which we discussed in subsection 2.2.1).
where $\overline{p}_i, i = x, y$ behaves according to equation (9). An inflated perception of care effectiveness induces individuals to underinvest in care, due to a false perception of their abilities.

According to empirical psychological studies, the illusion of control bias tends to appear in conjunction with the optimism bias. Luppi and Parisi (2009) analyze the conjunct effect of an optimism bias and the illusion of control bias in a bilateral care tort setting and investigate the care and activity incentives under different liability regimes. Depending on the liability regime, a moral hazard problem may arise either for the tortfeasor or the victim, when the law fails to incorporate the presence of positive illusions in individual behavior. Comparative negligence regimes are superior in contrasting the moral hazard problem created by positive illusion. Additionally, they show that the traditional equivalence between contributory and comparative negligence does not hold.

Inflated perceptions of care effectiveness may also be explained on the basis of other behavioral regularities, such as the restraint bias and the planning fallacy. People may overestimate their capacity to restrain from temptation, and consequentially, their ability to undertake effective care. For example, a young college student may think he can drive to a party and avoid drinking alcohol, but he may succumb to the temptation. Prior to the drink, his perceived care effectiveness is inflated because he may not sufficiently weigh the difficulties of restraining his behavior. On a similar note, an individual may fail to correctly estimate the amount of time needed to complete a task while meeting the due care standard. This may also produce an inflated perception of care effectiveness that can be illustrated using equation (9).

Ex-post effectiveness of care may also be reduced when individuals are not able to process the intensity of their current activity. Duration neglect bias (Redelmeier and Kahneman, 1996) identifies those situations where individuals cannot correctly perceive the length or intensity of the risky activity. Such individuals do not have a biased perception of their own care before exerting the activity, but during the activity, they cannot correctly assess the activity’s length or intensity, thereby causing an upward distortion of their perceived care, as modeled in equation (9). A biased perception of the duration of the activity may thus lead to diminishing care effectiveness, as the duration of
the activity increases. For example, a person may underestimate the need to take breaks while driving on a long trip, and her false perception of having driven less time may induce suboptimal levels of care or less effective quality of care.

The curse of knowledge (Camerer, Loewenstein and Weber, 1989) refers to skilled and trained individuals who tend to be less creative and accurate when performing activities in which they have accumulated knowledge. The reason behind this bias is that the emotional perception of self-assurance increases the perceived effectiveness of their care (as modeled by equation (9)). However, this mental attitude may actually decrease the accuracy of a knowledgeable individual’s care with respect to a less-informed person. One explanation is that trained people tend to devote less attention to routine activities and thus the precaution undertaken may be less effective.

A number of behavioral biases operate in the opposite direction, i.e., so that the effectiveness of care is decreased. The worse-than-average effect (Kruger, 1999) is a clear example. Individuals perceive themselves as less capable than other people in society. This implies that they feel less able to complete tasks or to perform well when facing a specific task. This induces a deflated perception of the effectiveness of their actions. Analytically, denote with \( p \) the subjective probability of an accident and with \( p_i = \frac{\partial p}{\partial t} \), \( i = x, y \), the distorted marginal effectiveness of care for the tortfeasor and the victim. Analytically, the worse-than-average effect causes a downward distortion in the perceived effectiveness of care. This can be expressed as follows:

\[
\left| p_i \right| < |p_i|, \ i = x, y \quad (17)
\]

In the presence of a worse-than-average effect, individual care is less effective than perceived. The first-order conditions for the tortfeasor and the victim will become respectively:

\[
-ewzp_x(x, y)[\alpha D + (1 - \alpha)S] = 1 \quad (18)
\]

\[
-wzp_y(x, y^*)[L - e[\alpha D + (1 - \alpha)S]] = 1 \quad (19)
\]
where $p_i, i = x, y$ behaves according to equation (17). A deflated perception of care effectiveness induces individuals to overinvest in care, adhering to a false downward-biased perception of their abilities.

Behavioral biases may also affect care effectiveness in both directions, depending on the context where a specific bias arises. An example is the attentional bias, which affects the way individuals process available information (Nisbett and Ross, 1980). People affected by an attentional bias tend to focus only on a subset of relevant information, disregarding wholly or in part other relevant information that has a correlation to their current decision. Empirical evidence suggests that drug users and, more generally, addicted individuals display attentional biases towards addiction-related events. This may help explain the frequency of relapses following treatments. In such cases, addicted individuals perceive the effectiveness of their care as higher than it actually is (as in equation (14)) and undertake less care toward their health than is socially optimal. In the presence of an attentional bias, anxious individuals focus on information more closely related to their concerns (Nisbett and Ross, 1980). This is an example where attentional bias causes a lower perceived effectiveness of care (as in equation (17)), leading individuals to focus on the relevant information above the socially optimal level.

### 2.2.3 Biases Affecting the Cost of Care

A crucial parameter when choosing the optimal precaution level is care costs. Several biases may induce a distorted perception of precaution costs, thereby affecting the incentive to undertake care.

Among the social biases, the self-serving bias creates a shield to protect and reinforce personal self-esteem (Sloan, Taylor and Smith, 2003). An individual exhibiting a self-serving bias tends to appropriate a greater share of a success to himself and attribute a greater share of his failures to others, based on his own personal merits and qualities. The self-serving bias may, therefore, induce people to overestimate the opportunity costs of their precautions, since they feel their efforts are better invested in other higher-valuing
activities because of their higher ability. Analytically, the self-serving bias can be modeled as a higher marginal precaution cost. Denote with $c(x)$ and $c(y)$ the perceived precaution costs for the tortfeasor and the victim, respectively. Under a self-serving bias, the marginal cost perceived by the individual, denoted with $c_i = \frac{dc}{dt}, i = x, y$, is higher than in the absence of any bias (which is set equal to one with no lack of generality):

$$c_i > 1, i = x, y \quad (20)$$

The privately optimal levels of precaution $x^*$ and $y^*$ are defined by the following first order conditions:

$$-ewzp_x(x, y)[\alpha D + (1 - \alpha)S] = c_x \quad (21)$$
$$-ewzp_y(x, y^*)[\alpha D + (1 - \alpha)S] = c_y \quad (22)$$

Since $p_t < 0$ and $p_{tt} > 0$, for $i = x, y$, the self-serving bias dilutes precaution incentives, causing the individual to undertake suboptimally low levels of precaution.

Behavioral biases may affect multiple dimensions. A number of other biases, listed in Table 1 and 2a and discussed in the previous subsections, may influence the individual perception of precaution costs in the same direction as the self-serving bias.

The restraint bias (Nordgren, van Harreveld, van der Pligt, 2009) creates higher precaution costs due to the individual’s inability to avoid engaging in risky activities. The planning fallacy (Kahneman and Tversky, 1979) instead determines higher precaution costs due to the individual’s inability to correctly process the information associated with the avoidance of risky activities. The illusion of control bias (Begg, Anas and Farinacci, 1992), the above-average effect (Alicke, Dunning and Krueger, 2005), and the curse of knowledge (Camerer, Loewenstein and Weber, 1989) induce the individual to perceive a higher opportunity cost of each unit of care, either because the individual feels she is better, more skilled, or more trained on a specific task. This can be modeled according to equation (20) and such phenomenon may arise either for the tortfeasor, the victim, or both. The psychological mechanisms that give rise to higher precaution costs (perceived

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6 For an application to litigation theory, see Babcock, Loewenstein and Issacharof, (1997).
or real) or the higher opportunity costs of taking precautions are specific to each bias, but in all such situations, they cause a dilution of care incentives.

People tend to exhibit time-inconsistent choices when facing a decision between a more immediate, but smaller, reward (or cost) versus a delayed, but larger, gain (or cost). Following the findings of Chung and Herrnstein (1967) and Ainslie (1974, 1975), individual time-inconsistent choices that produce a preference reversal over time can be explained by invoking hyperbolic, rather than exponential, discounting. Contrary to exponential discounting, where evaluations decay at a constant rate, hyperbolic discounting captures the idea that valuations decay at a higher rate for small delay periods, but at a lower rate over longer periods. Hyperbolic discounting thus produces a dynamic preference inconsistency where short-term preferences are inconsistent with long-term preferences. This relationship of inverse proportionality of delay over time can be applied both to rewards and costs decisions. Individual preferences affected by hyperbolic discounting are also said to be “present-biased.”

Although hyperbolic discounting has been studied in economics, a proper understanding of its consequences in legal applications is lacking. Hyperbolic discounting has been used to explain self-control problems, such as drug addiction or procrastination. It has also been used to explain retirement savings or credit card borrowings in economic settings. We suggest that hyperbolic discounting may also explain the choice of inefficient care levels. In a tort law context, hyperbolic discounting may induce an upward bias in the perception of immediate precaution costs in response to a “potential” loss faced in the future. To model hyperbolic discounting bias, we need to extend the model in Section 2.1 to consider time-inconsistent preferences. When individual preferences are biased toward the present, precaution involves immediate costs for a later uncertain reward, represented by a reduction in the expected liability in the event of an accident. Adopting the quasi-hyperbolic approximation proposed by Laibson (1997), the tortfeasor’s private objective function is changed as follows to account for the presence of hyperbolic discounting:

\[
\max_{(x,w)} F = V_T(w) - \epsilon w z p(x, y) \beta \delta^d [\alpha D + (1 - \alpha) S] - x(w)
\]
where $\beta \delta^d$ identifies the discount factor applied to the expected liability after $d$ periods. A similar analysis applies for the victim. The private optimal levels of precaution $x^*$ and $y^*$ are defined by the following first order conditions:

\begin{align*}
-ewzp_x(x, y)\beta \delta^d[aD + (1 - \alpha)S] &= 1 \quad (23) \\
-wzp_y(x, y^*)\{L - e\beta \delta^d[aD + (1 - \alpha)S]\} &= 1 \quad (24)
\end{align*}

In such situations, the tortfeasor has diluted incentives to undertake care, given that the immediate costs of precaution are weighted against delayed and discounted benefits. The opposite holds for the victim. The victim faces two immediate costs (precautions and accident loss), receiving a delayed and hyperbolically discounted compensation.

An interesting and specific application of behavioral bias in a tort law context is the discount-cost effect, identified by Porat and Tabbach (2011). After death, an individual associates a utility equal to zero to her wealth. This zero utility value produces a divergence between private and social incentives ex-ante and ex-post. The individual discounts the probability that she will die in any case with the cost of reducing her risk of death when deciding how much to invest in saving her own life. The discount-cost effect generates a deflated perception of precaution costs and leads individuals to overinvest in precautions above a socially efficient level.

2.2.4 Biases Affecting the Severity of an Accident

Biases affect the perception of the environment in which individuals operate and make their decisions, including their perception of the severity of a loss if an accident occurs. It is not surprising to imagine that an optimistic person will likely have a downward bias regarding accident gravity and a dilution of care incentive. Analytically, the perceived loss $L$ is lower than the objective one, $L$, i.e.,

$$L < L \quad (25)$$

and the private optimal level of precaution $x^*$ for the tortfeasor is defined by the following first order condition:
\[-ewzp_x(x, y)[\alpha L + (1 - \alpha)S] = 1 \quad (26)\]

A deflated gravity of accident produces a dilution of incentives, as it can be easily seen from inspecting equation (26). A similar result is attained in the presence of hyperbolic discounting. Individuals with preferences biased toward the present would discount the expected benefit of a loss reduction in the future, thereby leading to a dilution of incentives.

The opposite distortion occurs for a pessimistic person, facing an upward bias regarding accident gravity and excessive care incentives. Analytically, the perceived loss \( \bar{L} \) is higher than the objective loss, \( L \), i.e.,

\[ \bar{L} > L \quad (27) \]

and the privately optimal level of precaution \( x^* \) for the tortfeasor is defined by the following first order condition:

\[-ewzp_x(x, y)[\alpha L + (1 - \alpha)S] = 1 \quad (28)\]

The omission bias identifies situations where an individual evaluates a harmful action as worse than an omission producing the same negative consequence. In a tort context, this would mean that a person would view driving over the speed limit and causing the death of a pedestrian crossing the street to be morally worse than failing to slow down fast enough to avoid a car accident. This bias may induce an overestimation of accident gravity (according to equation (27)) and has very important implications for the estimation of damages and punitive damages.

An inflated perception of accident gravity may also occur in the presence of the inflating-benefit effect, identified by Porat and Tabbach (2011). This effect stems from the recognition that individuals assign a private value to the possibility of consuming their wealth while alive. This value, however, is not reflected in a social evaluation, since others may be willing to consume a specific individual’s wealth in the case of his death. The divergence between private and social evaluation of consumption of individual wealth may induce an overestimation of accident gravity and a resulting overinvestment of precautions above the socially optimal level.
There are a number of other biases that may also affect the perception of accident gravity in a less predictable way. A relevant psychological heuristic for the assessment of accident gravity is the anchoring heuristic, which may result in so-called hindsight bias (Fischhoff, 1992, 2002, Hawkins and Hastie 1990)). Individuals may anchor their estimates of the likelihood of an event or the size of a loss on the basis of the information available in their memory. In a tort context, an individual may overestimate or underestimate the size of an accident on the basis of information available from a similar accident she experienced or witnessed. When affected by a hindsight bias, individuals read ex-ante events in the light of ex-post events and information. This may lead them to distort the accuracy of their predictions, feeling reinforced on the basis of the information they have observed recently. This bias may induce either an underestimation or an overestimation of the gravity of the event, thereby inducing either diluted or excessive care or activity level incentives.

Other biases may produce uncertain consequences on care incentives. For example, the attentional bias (Nisbett and Ross, 1980) may produce opposite effects, depending on which information subset the individuals use to estimate the loss gravity. In some cases, the attentional bias causes excessive care, while in other contexts it may undermine the incentive to take efficient precautions. A similar logic applies when individuals adopt an anchoring heuristic (Tversky and Kahneman, 1974) or are affected by any other bias (listed in Table 1a) involving the choice of an anchor. Depending on the anchor chosen in the decision-making process, the individual may underestimate or overestimate the loss gravity, thereby diluting or reinforcing precaution incentives.

2.2.5 Biases Affecting Detection and Enforcement

In any legal problem, law provides efficient incentives only when paired with an efficient enforcement mechanism. In the absence of any enforcement mechanism, the effects of the law could vanish or be greatly reduced.7 This line of reasoning also applies in the tort law setting. As pointed out by Jolls (2005) psychological biases pose a distinct

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7 On the expressive effect of laws and the resulting levels of compliance in the absence of enforcement, see Cooter et al. (2008).
problem with respect to legal enforcement. In the absence of a perfect enforcement, behavioral biases may affect the perception of enforcement likelihood and introduce distortions in precaution choices. This is especially true when properly taking into account the contexts where people interact.

Conformity (Asch, 1955) may undermine the effectiveness of enforcement and cause a dilution of precaution incentives. Bandwagon effects (Asch, 1955) describe situations where people tend to conform to the observed behavior of others. Bandwagon effects is more likely to occur when the percentage of people who adopt the same behavior is higher. Individuals do not process the available evidence, but adopt the same behavior of others. For example, drivers tend to speed above the speed limit when other drivers do, independently of whether a speed control or a police patrol monitors the area. This may occur because individuals infer information from other people’s behavior. For example, each driver thinks that the other drivers are experienced on that route and know that speed limits are mildly enforced. Bandwagon effects may also occur because individuals prefer to conform. For example, a driver may dislike having drivers surpassing him and flashing lights, and may increase the speed to conform to others. Independent of the psychological mechanism originating conformity, bandwagon effects may determine a dilution of precaution incentives.

Among social biases, pluralistic ignorance (Katz and Allport, 1931, Prentice and Miller, 1993) identifies situations where a group of individuals conform to a (social) norm without rejecting it publicly, even if the majority of the individuals in the group privately reject it. Pluralistic ignorance is based on the false belief that the majority of the group accepts the norm and single individuals conform to it, in order to avoid being ostracized or secluded from the group. Krech and Crutchfield (1948, pp. 388–89) described the phenomenon of pluralistic ignorance as the “no one believes, but everyone thinks that everyone believes.” Prentice and Miller (1993) used pluralistic ignorance to explain the excessive alcohol consumption in parties among young students at Princeton University. Students there tended to drink more alcohol than they would otherwise. Rather than express openly their disagreement, students adapted to the norm, basing their judgment on the false belief that since everyone else is doing the same, it was the social

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8 See Bikhchandani, Hirshleifer and Welch (1992) for an economic application of bandwagon behavior.
norm. In such situations, the perception of enforcement of drinking laws is perceived as less important than social acceptance among the students and hence, this induces a dilution of incentives to comply with the law. Pluralistic ignorance helps also explain the higher tendency of individuals not to intervene in emergency cases when in a group than when facing the same situation alone. Seeing the other individuals not intervening induces the false belief that there is no necessity to intervene, rather than evaluating the opportunity to intervene on the basis of the gravity of the emergency. Highway speeding in mildly congested areas can also be used as an illustration of pluralistic ignorance when each driver infers from the behavior of others that it is safe and acceptable to drive above the speed limit.9

False consensus bias (Ross, Green and House, 1977) occurs when a person assumes incorrectly that he or she has more consensus than he or she actually has among peers in a group. This occurs despite of an open disagreement expressed by the others in the group. Hence, false consensus bias describes the opposite situation of pluralistic ignorance. False consensus bias may lead to underestimation of enforcement likelihood, based on the false perceived support in the community. This may cause a dilution of precaution incentives.10 Similar effects may be produced in the presence of other social biases, such as a social projection bias, a self-serving bias or an egocentric bias (Gilovich, Husted Medvec and Sativsky, 2000).

A dilution of precaution incentives may also occur when individuals have present-biased preferences. Enforcement can be perceived as distant in time and individuals prefer avoiding actions entailing an immediate cost to avoid bearing costs in the future, associated with their liability.

Omission bias (Ritov and Baron, 1990, 2004) works in opposite directions for harmful actions and harmful omissions. Since harmful actions are judged more severely than harmful omissions, the perceived enforcement should be higher for the former and looser for the latter. This implies that a potential tortfeasor may prefer to engage in

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9 An alternative explanation of the same phenomenon is the safety-in-numbers effect of having multiple speed-limit violators, each decreasing the probability of detection and enforcement for the others in the group.
10 False consensus bias may play a role in the justification of antisocial sexual behavior for sex tort perpetrators (see McAdams, 1997). See also Kahan (1997) for an analysis of the role of false-consensus bias in gang activity.
harmful omissions rather than undertake equally harmful actions.\textsuperscript{11} This may induce an individual to undertake a suboptimal mix of precautionary activities.\textsuperscript{12}

Anchoring heuristics may produce ambivalent effects on the perception of enforcement, depending on the anchor value chosen in the judgment. An individual who saw a police patrol on the way to work in the morning would more easily think that speed controls are enforced on the route he chose, thereby exerting more precautions in the afternoon on the way back from work. However, by the same logic, the same driver may think that speed control is not enforced if he never sees police on the route to work.

\textbf{2.2.6 Biases Affecting Litigation and Settlement}

After an accident occurs, parties have incentives to file for litigation and, once in litigation, to opt for an out-of-court settlement solution. The expected outcome of an out-of-court settlement operates like an expected damage award in the tortfeasor’s ex-ante incentives. Behavioral biases affecting the likelihood of contestants to win the litigation and/or the legal grounds of the litigation influence substantially the choice to enter litigation.

Loss aversion (Tversky and Kahneman, 1979,1991) may severely affect victim’s litigation incentives. The (emotional and/or material) loss imposed on the victim may be perceived as bigger because of loss aversion, thereby increasing the incentive to litigate or the amount $S$ for an out-of-court settlement. Status quo bias and endowment effect\textsuperscript{13} operate exactly in the same direction. This bias only affects the victim.\textsuperscript{14}

The confirmation bias (Nickerson, 1998) identifies the tendency for individuals to interpret evidence and available information in a selective way, in order to support their

\textsuperscript{11} See Chamallas and Wriggins (2010) for an application of omission bias to gender and minority discrimination in tort settings.

\textsuperscript{12} Zamir and Ritov (2012) examine how the combined effect of loss aversion and omission bias affects optimal litigation in civil settings, since a burden of proof is imposed on the plaintiff. The authors note that the omission bias raises de facto the actual standard of proof above the 51% threshold. Additionally, the authors suggest the adoption of a standard of proof should be set higher than 51% because of loss aversion.

\textsuperscript{13} A number of studies incorporate the endowment effect in a legal setting. Kahneman, Knetsch and Thaler (1990) examine the validity of the Coase Theorem in the presence of an endowment effect. Rachlinksii and Jourden (1998) focus on remedies, while Arlen, Spitzer and Talley (2002) study a corporate agency setting when endowment effect is present.

\textsuperscript{14} See Zamir (2012) for an application of the loss aversion in a law context.
own viewpoint or confirm their own beliefs. Individuals affected by a confirmation bias tend to refute any evidence contradicting their beliefs. For example, a victim involved in an accident tends to analyze the events that led to the accident in such a way as to minimize his fault and to support more strongly his entitlement to damages. This may affect the individual incentives to enter litigation and the willingness to settle out-of-court. It is more likely that in the presence of a confirmation bias, individuals will file for higher compensation damages $D$ or expect a higher out-of-court settlement opportunity $S$, in order to drop the case. This will lead to a contraction of the settlement opportunities set and an expansion of the litigation set.

The choice of entering litigation can be substantially influenced by the perception of self in society. People who regard themselves as highly supported by the other individuals in the group they belong to (at work, in the family, in their religious community, etc.) may have a higher tendency to enter litigation, basing their choice on the false beliefs that their reasons or emotional states are widely accepted and shared by others. People affected, for example, by a false consensus bias (Marks and Miller, 1987), an egocentric bias (Gilov, Husted Medvec and Sativsky, 2000), a self-serving bias (Sloan, Taylor and Smith, 2003), or a social projection bias (Loewenstein, O'Donoghue and Rabin, 2003) may engage in more litigation than is rationally optimal.

Hindsight bias (Fischoff, (1992, 2002), Hawkins and Hastie (1990)) creates pervasive problems in the court’s or jury’s assessment of the ex-ante probability of an accident or level of care undertaken by the parties. The fact that the accident has de facto occurred leads a decision-maker to infer that the ex-ante probability of occurrence must be higher and/or that the parties must have failed to do what was necessary to avoid the accident. This may lead to the ex-ante excessive precautions and other distortions in the standard tort problem.\(^\text{15}\)

Anchoring heuristic (Tversky and Kahneman, 1974) may affect the incentive to enter litigation or settlement in opposite directions. Consider a tortfeasor involved in an accident. He may recall a recent case from the news, where the jury awarded punitive

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\(^{15}\) See Peters (1999) for an application of hindsight bias in tort liability. See also Stallard and Worthington (1998) for the strategic use of hindsight bias in the attorney closing statements to affect jurors’ recall of evidence.
damages in a very similar context.\textsuperscript{16} In such a situation, he may overestimate the damage award he faces, and may be more willing to settle out-of-court. A different tortfeasor may have been involved in a similar accident before and not held liable.\textsuperscript{17} This may induce the tortfeasor to face litigation rather than to offer a settlement.\textsuperscript{18} Ambiguous effects on litigation and settlement choices may also be caused by conformity with the behavior of other individuals in society (due to pluralistic ignorance or bandwagon effects). For example, a person could file against the plaintiff in a class action, even though he would never file alone. Symmetrically, a contestant could accept a settlement offer, that he would have never agreed upon, if others do.

Litigation and settlement opportunities may be substantially affected by the presence of memory biases in the individuals. People may have memory lapses or selective memories that affect their perception of the events that led to the accident, thereby changing their perceived entitlement to damages (van der Kolk and Fisler, 1995). For example, after an accident, most people experience the recurrence of memories of the accident, even if unwanted. The persistence of traumatic memories may reinforce his feelings that the victim deserves substantial compensation or the rightness of his desire to punish the tortfeasor. This may lead to increase litigation incentives and reduce settlement opportunities. After traumatic events, people may also experience false memory, perceiving imagination as a memory (Loftus, 1980). This memory misattribution may increase, for example, the victim’s perception of damage entitlement, making the victim more inclined to litigate or less willing to accept a settlement out-of-court.

Some biases may produce opposite effects, depending on whether the memory retained will induce the person to perceive it has a weaker claim or, on the contrary, to

\textsuperscript{16} See Sunstein, Kahneman and Schkade (2000) for an analysis of the impact of psychological biases on the assessment of punitive damages.

\textsuperscript{17} See Collins, Graham, Hansen and Johnson (1985) for the tendency of individuals to anchor with past, retrospective bias. See also Epley, Keysar, Van Boven and Gilovich (2004) for the individual tendency of anchoring with themselves, adopting an egocentric anchor.

\textsuperscript{18} The defensive attribution hypothesis affects litigation in an indirect way. It becomes especially relevant in a jury context or for a witness’s performance at trial. Eye-witnesses to a different accident than the one at trial tend to attribute responsibilities not on the basis of an objective evaluation of what they have observed directly or the evidence brought to trial. On the contrary, they are more severe in their judgments, depending on the greater the loss caused by the accident and the more similar they are to the victim. (see Burger, (1981), Salminen (1992), Bornstein (1998).
deserve justice and due compensation in torts. Among others, bizarreness leads individuals to remember more easily highly unlikely events rather than ordinary or more frequent daily events, (Lamay and Riefer, 1998) Memory may fail to retain the sequence of events depicting the accident dynamics. This may occur, for example, because of the so-called context effect, (Schwarz and Sudam, 1992) according to which people are less able to retrieve correct memories, when they are recalled out of the context where those memories were generated. Memory mistakes may also arise due to a misinformation effect, (Loftus and Hoffman, 1989) when people report incomplete or false memories due to misinformation. People may also be misled by the illusion-of-truth effect (Begg, Anas and Farinacci, 1992) Independently of the truthful or false content of a statement, individuals are more inclined to believe in familiar statements (which they have heard previously and repetitively) than in a statement heard for the first time.

3. Conclusions

A growing body of law and economics literature focuses on the departure of human behavior from full rationality and the attempt to explain the positive and normative implications of bounded rationality in the formulation of legal policy. Sunstein (1997) and Jolls, Sunstein, and Thaler (1998) point to the need for a more accurate understanding of behavior and individual choice in the legal context in order to take into account shortcomings in human behavior when structuring the law.

In this paper, we contribute to the field of behavioral law and economics, considering how to represent the impact of behavioral, cognitive, and social biases on the behavior of parties in a tort problem. This exercise provides two useful building blocks for a more systematic development of the field of behavioral tort law. In the first building block, we highlighted the most relevant ways in which biases affect decisions in the context of a tort. To this effect, we have identified several categories of effects, ranging from biases that affect the parties’ ex-ante perceptions of probabilities, accident loss, effectiveness or cost of care, and probability of detection and enforcement, to biases that affect the parties’ ex-post evaluations of the merits of their case, gravity of the loss, and settlement opportunities.
The second building block consists of a stylized algebraic representation of the biases in the context of a tort problem. Most of the results in the law and economics literature build on the standard tort model developed by Shavell (1980 and 1987). In this paper, we have shown how behavioral, cognitive, and social biases can be incorporated in the standard model. For each group of cases, we have derived the first-order conditions to obtain a first glance at the effects of biases on incentives. This exercise aims at offering a uniform modeling language to capture the important findings of the behavioral literature within the standard model of tort law.
References


