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Lapses, Conflict and Akrasia in Torts and Crimes

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LAPSES, CONFLICT, AND AKRASIA IN TORTS AND CRIMES: TOWARDS AN ECONOMIC THEORY OF THE WILL

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Decision makers in economic theory possess preferences and information. Rationality consists in making decisions that maximize the expected satisfaction from available opportunities. This simple model of decision making does not encompass conflicting motives. It has no scope for tension between one desire and another, or between a desire and a duty. It offers no account of how or why a person might vacillate between alternatives when deciding what to do, or regret what he did. Nor does it explain why a person with the same preferences and information might act differently at different times in the same circumstances. The rationality assumptions in standard economics are too severe to encompass conflicting motives and inconsistent behavior.

The power of a person to suppress conflicts between motives and act consistently is usually called strength of will. Conversely, responding to immediate circumstances and acting from impulse is often called weakness of will. People often commit torts or crimes due to weakness of will. To illustrate, Stanton Wheeler summarized six years of research on white collar crime by citing a felon's "sad tale": ". . . when my brothers told me that the scheme [to defraud the bank] was necessary to save the business, I agreed to the plan, even though I knew it was wrong . . . If my brothers were so close to closing those deals, that would save everyone, I had to give them a chance. To take a chance for them and their families and I for my own family. I am sorry I broke the law, sorry for all my mistakes, sorry so many innocent people got hurt."[1] Economics cannot make sense of such an utterance without an account of psychological conflict and regret.

Philosophers traditionally include "will" as one of the major faculties of mind, along with reason and the appetites.[2] Wrongdoing resulting from weakness of will

[1]Stanton Wheeler, "White Collar Crime: Some Reflections on a Socio-Legal Research Program," paper prepared for Edwin Sutherland Conference on White Collar Crime, Indiana University, May 1990, p. 34, quoting Mitchell Lewis Rothman and Robert P. Gandossy, "Sad Tales: The Accounts of White Collar Defendants and the Decision to Sanction," *Pacific Sociological Review*, vol. 25, number 4, Oct. 1982, pp. 449–74.

[2]This is Plato's distinction in *The Republic*.

has been analyzed by philosophers since Aristotle under its Greek name, *akrasia*. Most accounts attribute akrasia to intemperance or a lack of courage, which in turn results from bad habits and defective moral training. A persistent aim of this tradition is explaining how reason can gain control over the appetites.[3]

This philosophical tradition is connected to theories of developmental psychology which hold that personality growth accelerates during the stages in life when strong desires collide.[4] At these stages in life, a person must develop strategies for reconciling conflicting motives. Therapies often try to eliminate dysfunctional responses to conflicting motives and substitute in their place a more orderly satisfaction of reasonable desires. A full theory of psychological conflict would explain how to reinforce one motive at the expense of others. Such a theory would apply to preventing accidents and crimes through education and rehabilitation. Economic theories of decision making need to be extended in order to make contact with these traditions in philosophy and psychology.

Preferences vary over time according to patterns that psychology and biology can only partially explain or predict. Mood, saliency, deprivation, hormonal balance, stimulation, and spontaneity inject elements of randomness in decision making. When preferences vary, behavior is inconsistent and motives conflict. A person who is aware of this fact can make choices that strengthen one motive at the expense of another.

Thus a theory of the will must encompass at least three related phenomena concerning preferences: variation, conflict, and self-development. These phenomena form a natural ordering by complexity, which suggests three nested models. This article develops models of the first two phenomena, but not the third. In the first model, I assume that a self-interested decision maker faces the choice of whether or not to commit a very risky crime or tort, which a risk-averse person would shun. The decision maker's preferences for futurity and risk are neither completely stable nor completely predictable. This is modeled by assuming that the decision maker draws his discount rate for time and uncertainty from a probability distribution. The decision maker forbears when he draws preferences from the usual range, but he commits the tort or crime on the rare occasions when he draws preferences from the tail of the distribution where uncertain or future costs are discounted very highly. I refer to such acts as "lapses." Lapses in this model concern temporary mistakes in preferences, rather than mistakes in memory, attention, or skill.

In the second model, the decision maker experiences regret when he lapses. To model regret, I assume that the decision maker knows the probability distribution from which his future preferences will be drawn. In this context, regret has a simple definition: A decision is regretted if, given his new preferences, the actor would not have made it. The decision maker forms an expectation about the extent of his future regret from committing the tort or crime. He decides what to do by balancing expected regret against the satisfaction from acting on immediate impulses.

The models of lapses and regret are developed using graphs and propositions that are proved in the appendix. Policy implications for the law of torts and crimes are discussed. In general, lapses are best deterred by mild sanctions applied with high probability, rather than severe sanctions applied with low probability. Furthermore, regret provides an economic rationale for paternalism.

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[3]The concept is usually attributed to Aristotle. The classical text with commentary and various essays is in Mortimere (1971). Also see Rorty (1980).

[4]This view of developmental stages is found in Freud (1962) and elaborated by Erikson (1968).

My models are inspired by but do not emulate previous economic analysis. Conflicting motives have been analyzed using economics by Schelling (1984, 1985, 1986), Elster (1979), Thaler and Shefrin (1981), and Simon (1990). The problem of consistent decisions over time has been analyzed by Strotz (1956), Goldman (1980), von Weizsacker (1971), Becker (1968), and others. The application to law follows suggestions by Diamond (1974), Shavell (1987), Schwartz (1978), Grady (1988), and the work of E. Scott (1990).

A. MODEL OF LAPSES

The model of lapses is reduced to its simplest elements in the decision tree in Figure 1. At the first branching of the tree, the decision maker draws risk preferences, denoted t, from a probability distribution. At the second branching, the decision maker chooses between forbearing, which pays 0, and acting. Acting, which involves committing a tort or crime, yields benefits b with certainty and costs c with probability p, where c is much larger than b.

The valuation of the alternatives is based upon the preferences towards risk that were drawn at the first branching. The expected value of the gamble, denoted EV, equals the certain benefit minus the expected cost:

$$EV = b - pc.$$

The class of torts or crimes in question are very risky by assumption: $EV << 0$ or $b << pc$. The certainty equivalent of the gamble, denoted CE, equals its expected value adjusted for preferences towards risk. The adjustment term is denoted r:
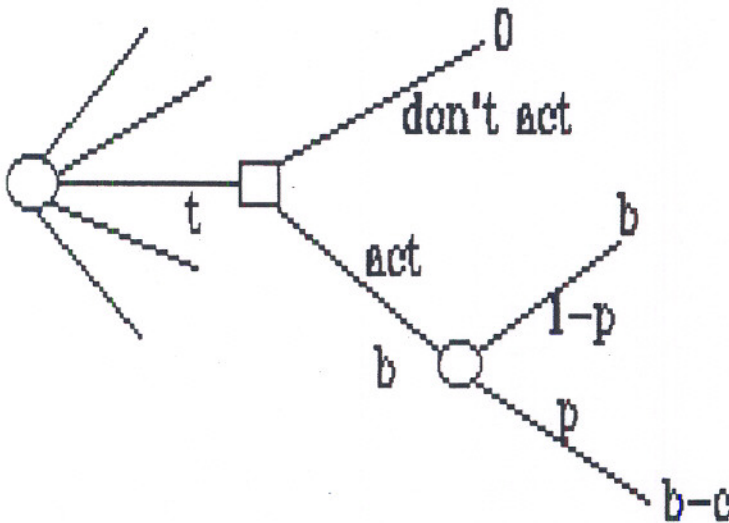
$$CE = b - pc/r.$$
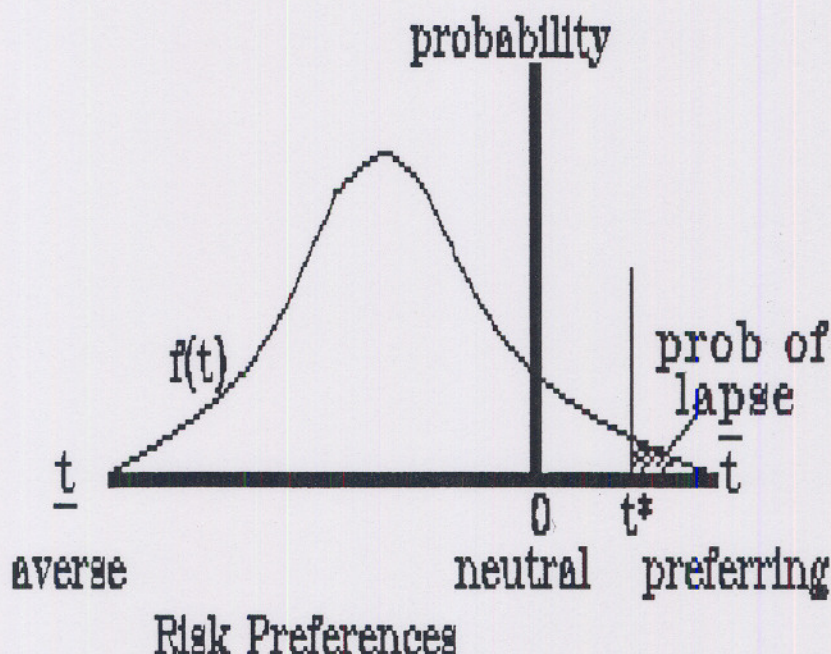

FIGURE 1. Decision to act

FIGURE 2. Probability of lapse

r depends upon the objective risk, which can be represented by the variance in costs, denoted by σ^2, and the subjective risk preferences t:

$$r = r(\sigma^2, t).$$

The parameter t, which is precisely defined in the mathematical appendix, is drawn from a probability density function $f(t)$, which is illustrated in Figure 2. $t = 0$ indicates risk neutrality, $t < 0$ indicates risk aversion, and $t > 0$ indicates a positive preference for risk. Most of the density of $f(t)$ lies in the region $t < 0$, where the decision maker is averse to risk. The most probable preferences exhibit aversion to risk, neutrality, or a moderate preference for risk. A draw of preferences from the tail of the distribution, where risk-taking is strongly preferred, is improbable.

The tipping point t^* is the value of t where the decision maker is indifferent between forbearing and acting. To be precise, t^* is defined by the equation

$$0 = b - pc/r(\sigma^2, t^*).$$

For $t < t^*$, the decision maker forbears, and for $t \geq t^*$, the decision maker gambles. I am modeling the special class of high risk torts and crimes where $EV \ll 0$, so t^* must lie in the right tail of the distribution in Figure 2 where $t^* \gg 0$. I refer to acting as "lapsing." The probability of lapsing equals the density to the right of t^*, which is shaded in Figure 2. (In a more general model than mine, the expected value of the gamble could be positive, $EV > 0$, in which case t^* could be in the risk-averse range, $t^* < 0$.)

The torts and crimes contemplated in this model are so risky that only risk

preferrers would commit them. So the decision maker acts and takes the gamble only when he draws strongly risk preferring preferences. For a risk preferring decision maker, an increase in risk makes a gamble more attractive. Consequently, an increase in risk increases the frequency of the torts and crimes modeled here.

This idea will be formulated more precisely. By definition, a "mean-preserving spread" in any probability distribution shifts density from the center to the tails so that the mean remains constant and the variance increases. I first consider a mean-preserving spread in the objective distribution of possible payoffs. The following proposition is proved in the appendix:

PROPOSITION 1. A mean-preserving spread in the distribution of payoffs increases the probability of a lapse.◄

Proposition 1 asserts that a decrease in the probability of costs p and an offsetting increase in their magnitude c, which leaves the expected costs unchanged, will result in more lapses.

As an aside, note that the model in Figure 1 concerns preferences towards risk, but the results would remain true if preferences towards futurity were included in it.[5]

Proposition 1 concerns the consequences of a mean-preserving spread in objective payoffs. Now I will develop a second proposition that concerns the consequences of a mean-preserving spread in the distribution of subjective risk preferences $f(t)$.

PROPOSITION 2. A mean-preserving spread in the distribution of preferences towards risk, $f(t)$, may increase and cannot decrease the probability of a lapse.◄

The truth of this proposition is seen in Figure 2. A mean-preserving spread in the distribution $f(t)$ does not change the tipping point t^*. However, a mean-preserving spread in $f(t)$ shifts density in Figure 2 from the center to the tails of the distribution. The shaded area, which indicates the probability of a lapse, is in the right tail. Hence the spread in density may increase and cannot decrease the shaded area.

The preceding predictions have consequences for optimal deterrence. A simple model of deterrence measures the social cost of lapses by the sum of their expected harm and the cost of deterring them. The expected harm encompasses the external harm suffered by others and any internal costs borne by the wrongdoer. The cost of deterring lapses includes the cost of imposing sanctions. Interpret the cost c as a sanction and the probability p as the probability of enforcement. Proposition 1 implies that, when certainty and severity cost the same, optimal deterrence is achieved when sanctions are applied with maximum certainty. The same is obviously true when severity costs more than certainty.

PROPOSITION 3. If the cost of incrementing the sanction is at least as great as the cost of incrementing the enforcement probability, then optimal deterrence of lapses is achieved when the sanction is applied with probability 1.◄

[5]The benefits b are realized before the possible costs c. Hence c could be discounted for futurity. Furthermore, the time discount could be drawn from a probability distribution. As with risk, the person would be more likely to act when preferences were drawn from the tail, where futurity is heavily discounted.

B. POLICY IMPLICATIONS OF THE MODEL OF LAPSES

Some sanctions, such as capital punishment, are very costly to impose in America. Other cheaper sanctions, such as imprisonment and probation, are still costly. Probability and severity substitute for each other as deterrents. Proposition 3 concerns circumstances in which the incremental costs of more severe sanctions are at least as large as the incremental costs of apprehension and prosecution. Under these circumstances, optimal deterrence of wrongs arising from lapses requires mild sanctions applied with high probability. This result will be true of many serious crimes punishable by imprisonment.

In contrast, optimal deterrence requires severe punishments applied with low probability whenever severity is much cheaper than certainty. Fines are cheap relative to apprehending offenders. The optimal fine for deterrence, consequently, is the highest fine that the offender can pay, which is levied with small probability. This is a standard result in the economic analysis of deterrence.[6] Proposition 3 complements the standard result in that one applies to many offenses punishable by fines, and the other applies to many offenses punishable by imprisonment.

Academics and reformers who study crime often argue that imprudent criminals discount uncertain future punishments so highly that severe punishments will not deter them. The reformers commend mild punishments applied with high probability.[7] Proposition 3 thus suggests an economic foundation for liberal reform of criminal sanctions.

Another consequence of Proposition 3 concerns the usefulness of ex ante regulation as opposed to ex post liability. Ex ante regulation usually refers to supervisory activities of government agencies, such as creating and enforcing safety standards. The term can also be applied to the monitoring of policy holders by insurance companies and other guarantors. Indeed, an insurance market can be viewed as a device to deter accidents by transforming ex post liability into ex ante regulation. Whether public or private, regulation imposes relatively small sanctions for acts before they cause harm, rather than imposing large sanctions for harm after it occurs. Ex ante regulation can overcome the problem of lapses created when ex post sanctions are applied with low probability.

Proposition 2 has important policy implications for predicting lapses and targeting policies to prevent them. It suggests targeting people who draw their attitudes towards risk from a distribution with high variance. A variety of scholarly literature is relevant to identifying this population. Wilson and Hernstein (1985) review the empirical and theoretical literature on the causes of crime. They argue that attitudes towards risk and futurity are especially important determinants of the propensity to commit crime.[8] Wheeler's exhaustive study concludes that white collar crime is especially likely to occur when the prospect of an abrupt fall in wealth changes attitudes towards the risk of wrongdoing. Wheeler supports this conclusion by reference to psychological studies of risk, especially that by Kahneman and Tversky (1979).

Variability in attitudes towards risk may increase in response to biological rhythms. Withdrawal and satiation among drug addicts is a well documented example (Rosenbaum, 1981), but other cyclical phenomena may also have a role,

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[6]Becker (1968); Polinsky and Shavell (1979; 1984); Kaplow (1989).

[7]"Since Becarria it has been generally accepted that certainty of punishments is more important than severity, and research gives some support for this assumption." Johannes Andenaes (1983).

[8]See especially "Delay and Uncertainty," pages 49–56. The authors also assert that "People who break the law are often psychologically atypical" (page 173).

such as sleep deprivation or menstruation.[9] Progressive phenomena such as aging apparently have an important effect.[10] Furthermore, attitudes towards risk may shift in response to personal experiences. To illustrate, defense attorneys often argue that psychological trauma mitigates the seriousness of the crime.[11] Emotional state may influence behavior in a variety of legal contexts.[12]

Schwartz (1978) and Grady (1988) have suggested that people commit torts in a moment of forgetfulness or weakness. Sometimes the "cost of remembering" the legal rule is too high. Similarly, Perloff and Rubinfeld (1988) have argued that special attitudes towards risk may motivate antitrust torts and crimes. The model of lapses reconciles this idea with the fact that most people are averse to large risks most of the time.

C. A MODEL OF REGRET

In the model of lapses developed in the preceding sections, the decision maker draws preferences from a probability distribution and acts upon them. This model does not contemplate conflict among competing motives. The decision tree in Figure 1 is modified in Figure 3 in order to represent conflict. As before, the decision maker draws risk preferences, denoted t_0, at the first branching of the tree in Figure 3. As before, he decides whether to forbear or gamble at the second branching. At the third branching, however, he draws risk preferences from a probability distribution a second time, denoted t_1. In the final stage of the decision tree, the uncertain costs of the gamble (if taken) are resolved. So the change from Figure 1 to Figure 3 introduces a temporal sequence of preferences, t_0 and t_1, which may conflict.

The decision maker may act on immediate preferences t_0, the distribution of future preferences $f(t)$, or some combination of them. Economists beginning with Strotz (1956) have investigated the problem of consistency in preferences over time. General solutions have been proposed for problems involving "multiple selves."[13] A general solution, however, does not lead to specific predictions about torts and crime. A simple representation seems best for my purposes, even though mathematical elaboration will, no doubt, reveal its implicit limitations.

I model the decision as weighing an index of present and future satisfactions. For any specific preferences t, the gamble has a certainty equivalent:

$$CE(t) = b - pc/r(\sigma^2, t).$$

The satisfaction of immediate impulses has a value whose certainty equivalent is denoted $CE(t_0)$, where

$$CE(t_0) = b - pc/r(\sigma^2, t_0).$$

However, the satisfaction of immediate impulse may result in future regret. Regret arises because the actual preferences t_1 are different when the risk materializes

[9]See Reid and Yen (1983).

[10]"None of the correlates of age, such as employment, peers, or family circumstances, explains crime as well as age itself." Wilson and Hernstein (1985), page 145.

[11]For a series of such cases, see Monahan and Walker (1990), pages 359–93.

[12]For a game theory model, see Huang and Wu (1989).
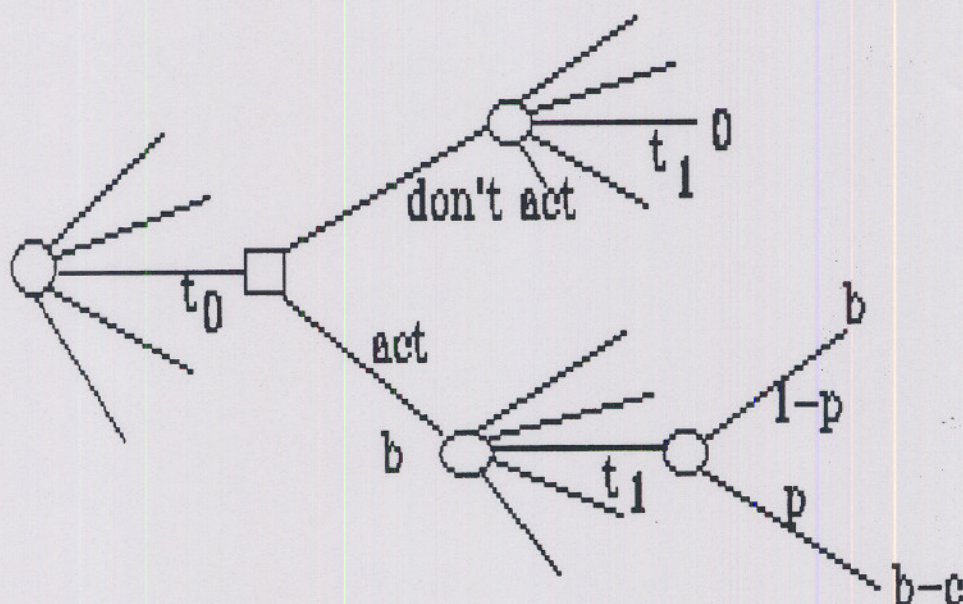
[13]See, for example, Simon (1990).

FIGURE 3. Regret

than when the decision was made to act. A measure of regret is the certainty equivalent when the risk materializes:

$$CE(t_1) = b - pc/r(\sigma^2, t_1).$$

By assumption, the torts or crimes in question are so risky that the certainty equivalent for most values of t_1 is negative. Earlier I defined a regretted decision as one that the actor would not have made, given his new preferences. Thus the expected regret can be defined as

$$ER = - \int CE(t_1) f(t_1) \, dt_1.$$

Present satisfaction and future dissatisfaction are both considered by a rational decision maker. In my model, these considerations result in an ordering of impulse satisfaction, $CE(t_0)$, and expected regret, ER. I assume that the decision maker combines current and future preferences towards risk into a single ordering, denoted w and defined by

$$w = w(CE(t_0), ER),$$

where $w_1 \geq 0$ and $w_2 \leq 0$. The two terms in w indicate current satisfaction and the anticipation of future dissatisfaction with the decision.

The application of w to the choice described by Figure 3 is depicted in Figure 4. The strength of the impulse to act is measured on the vertical axis, and the extent of expected regret is measured on the horizontal axis. In this decision problem, forbearing yields a payoff of 0, which yields $w(0,0)$. It is convenient to normalize w so that $0 = w(0,0)$. Hence the decision maker acts if $w \geq 0$ and forbears if $w < 0$. The indifference curve $w = 0$, which is depicted in Figure 4, bisects the graph into two zones according to whether the decision maker acts or forbears.
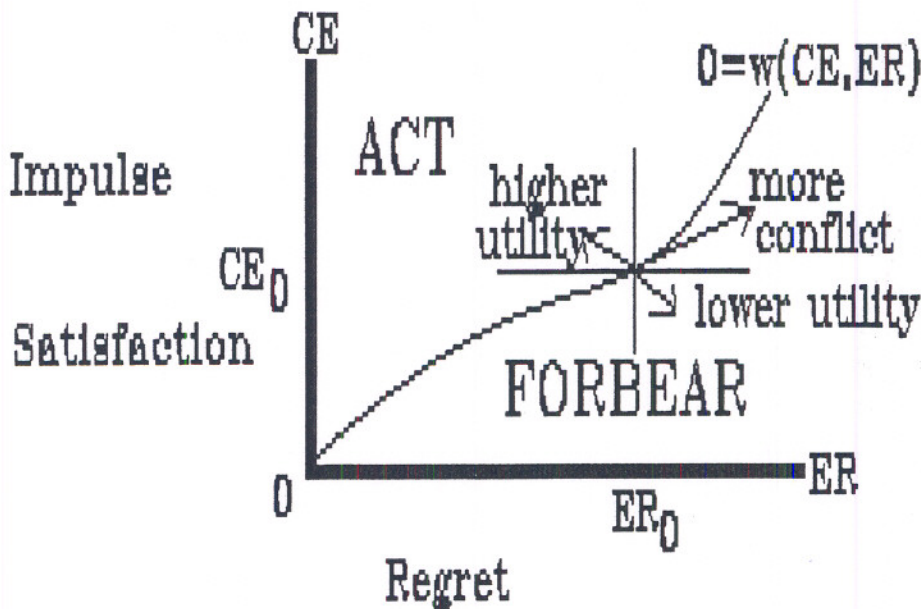
FIGURE 4. Impulse and regret

At all points above $w = 0$, the impulse to act outweighs expected regret, whereas the opposite is true at all points below $w = 0$.

Consider starting from any point on $0 = w$, such as (CE_0, ER_0), and moving in various directions. A move to the northwest represents an increase in impulse satisfaction and a decrease in expected regret, which is unambiguously preferred ($w > 0$). Conversely, a move to the southeast results in less impulse satisfaction and more expected regret, which is unambiguously not preferred ($w < 0$).

The following proposition is easily proved:

PROPOSITION 4. An increase in expected regret results in fewer lapses. ◄

This general result, which does not depend upon the specific features of the function w assumed in my model, is easily explained. Expected regret always prompts forbearance when the acts in question are very risky torts or crimes. Overcoming greater expected regret requires a stronger impulse to immediate action. In other words, the immediate preferences must be drawn from farther in the tail of the distribution.

This proposition suggests the relationship between the model of lapses and the model of regret. For any particular gamble, the model of regret defines a tipping value, denoted $t\sim$, which is defined by

$$0 = w(CE(t\sim), ER).$$

A decrease in expected regret undermines the motive for forbearing, so the tipping value $t\sim$ decreases. As expected regret falls to zero, the model of regret collapses into the model of lapses:

$$0 = w(CE(t^*), 0).$$

Now I consider the consequences for optimal deterrence when actors become more prudent and give more weight to expected regret. The following proposition is proved in the appendix.

PROPOSITION 5. An increase in the subjective weight given to expected regret can cause the optimal expenditure on deterrence to increase or decrease.◄

It is not hard to see why Proposition 5 is true. Giving greater weight in decision making to expected regret has two contradictory effects. First, the tipping point moves farther into the right tail of the distribution, as indicated by Proposition 4. As a consequence, fewer decision makers are near the tipping point where they will be deterred by greater sanctions. This "density effect" causes the optimal expenditure on deterrence to fall.

Second, those decision makers who are near the tipping point respond more to an increase in the possible sanction. They respond more because expected regret influences them more. This "responsiveness effect" causes the optimal expenditure on deterrence to rise.

D. POLICY IMPLICATIONS OF THE MODEL OF REGRET

Proposition 4 asserts that fewer lapses occur when the decision maker gives more weight to expected regret. Expected regret is likely to receive more weight in a considered judgment than in a hasty or pressured decision. The law has various devices to slow down the decision process and reduce pressure. For example, some American states have legislated "cooling off periods" that permit a person who makes a purchase from a door-to-door salesman to renounce the contract within a specified period of time.[14] More generally, the unconscionability doctrine has often shielded promisors from contracts formed under conditions that obstructed a considered judgment ("transactional incapacity").[15]

Many laws such as social security adopt a paternalistic attitude towards the public. Paternalism substitutes the judgment of officials for the judgment of a policy's beneficiaries. The usual rationale for paternalism is that people follow their spontaneous impulses too much. Policy makers allegedly save people from regret. To illustrate, the poor are often given goods such as health care rather than money ("specific egalitarianism"; see Tobin, 1970).[16] Similarly, Pigou (1920) argued that people are too short-sighted to save and invest enough money. He advocated government policies to increase the nation's savings rate and to increase human capital investment through expenditures on health and education.[17]

An economic defense of paternalism requires a theory of how institutions correct failures in individual choice. For example, democratic institutions ideally reach decisions by aggregating people's preferences, so that public choice expresses the average preferences of people. This ideal is realized by a voting equilibrium corresponding to the median rule. If the average preferences of voters

[14]The FTC's "cooling off" rule is in 16 C.F.R. #429.1.

[15]The connection between these legal doctrines and theories about psychological states is made by Eisenberg (1982).

[16]Some goods, such as medical services, are difficult or impossible for recipients to resell. Others, such as food stamps or vouchers, can be resold at a discount, and reselling involves transaction costs. The necessity of resale in effect raises the price of using a voucher to buy goods other than the ones for which it was intended.

[17]Note that some passages from Pigou express faith in the working class and limit or disavow paternalism.

resemble the considered preferences of each person, then the median rule comes close to maximum satisfaction of considered preferences. Thus the model of regret can provide a respectable rationale for some forms of paternalism. (Unfortunately, it also provides an ideological tool to disguise antidemocratic abuses and rent-seeking, but that is another topic.)

In practice, the law typically regards torts or crimes as less serious when they are spontaneous rather than considered.[18] To illustrate, a husband who finds a man in his wife's bed is not so severely punished in many societies for shooting him instantly while in a rage than for shooting him two months later. This feature of law can be explained by the fact that acts motivated by spontaneous and powerful emotions are thought to be less responsive to punishment than are considered acts.

Responsiveness is less because expected regret receives more weight in a considered decision than in a spontaneous, emotional act. Proposition 5 asserts that the optimal sanction for deterrence may increase or decrease with the weight given to expected regret by the decision maker. The optimal sanction tends to increase because the considered act is more responsive to the expected sanction ("responsiveness effect"). This is the rationale just cited. The optimal sanction tends to decrease because there are fewer occasions on which the decision maker requires a larger sanction to prevent him from lapsing ("density effect"). Thus the fact that torts or crimes typically receive more severe punishment when considered rather than spontaneous would be optimal if that the responsiveness effect dominates the density effect.

CONCLUSION

An economic model of the will has been constructed to allow for lapses and regret. This model has been used to reach conclusions about tort law and crimes that differ from the usual economic recommendations. Law should combat harms caused by lapses through incentives that address unusual preferences towards risk and futurity. Frequent, mild punishment is favored over infrequent, harsh punishment. Frequent punishment strengthens the will to resist the impulse towards wrongdoing.

Economics must overcome the prejudice that behavior is real but thoughts are not. Mental processes for reaching decisions must be modelled in order to predict how people behave. The standard model of decision making must be expanded to encompass the doubts, hesitations, conflicts, and regrets that afflict us. A language and economic theory of human failure must be developed. I have tried to model akrasia and weakness of will in order to bring economics in contact with much older traditions in philosophy and psychology. If people think about a problem for two thousand years, they learn something about it; if they model it, they can learn more.

MATHEMATICAL APPENDIX

Model of lapses

The decision maker can act or forbear. Forbearing pays 0, whereas acting pays b and costs c with probability p, where $0 >> b - pc$. The decision maker draws preferences towards risk from a probability density function $f(t)$. The draw deter-

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[18]There are special circumstances under which consideration before inflicting a harm excuses the wrong. For example, harm may be inflicted in order to avoid a larger harm.

mines a von Neumann-Morgenstern utility function u. The certainty equivalent of the gamble, denoted CE, solves the equation

$$u(CE) = pu(b-c) + (1-p)u(b).$$

A risk discount r is defined by

$$CE = b - pc/r.$$

To simplify, assume that r can be approximated by a linear function of the variance σ^2 and a pure taste term t. I assume that σ^2 is in the range $[0,1]$.[19]

$$r = t.\sigma^2 + 1$$

where

$$t < 0 <=> \text{risk-averse,}$$
$$t = 0 <=> \text{risk-neutral,}$$
$$t > 1 <=> \text{risk-preferring.}$$

CE is increasing in t. Thus the certainty equivalent can be written

$$CE = b - pc / (t.\sigma^2 + 1), \tag{1}$$

where

$$CE \geqslant 0 <=> \text{do the act,}$$
$$CE < 0 <=> \text{don't do the act.}$$

The condition for acting can also be rewritten

$$t \geqslant t^*, \text{ where } t^* = \{(1/\sigma^2) \cdot (pc - b)/b\}. \tag{2}$$

t^* is the tipping value of t. Thus the probability of a lapse, denoted p_L, is given by

$$p_L = \int_{t^*}^{t} f(t)dt. \tag{3}$$

PROPOSITION 1. A mean-preserving spread in the distribution of payoffs increases the probability of a lapse.◄

PROOF:

1. A mean-preserving spread increases σ^2 while leaving pc unchanged.
2. $\dfrac{\partial p_L}{\partial \sigma^2} = -f \dfrac{\partial t^*}{\partial \sigma^2}$ from (3) above.
3. $\dfrac{\partial t^*}{\partial \sigma^2} = \underbrace{(pc-b)/b}_{+} \cdot \underbrace{(-2/\sigma^3)}_{-} < 0$ from (2) above,

[19]Note that the payoff is either b or $c - b$, so the deviation equals $c/2$, and the variance equals $c^2/2$.

which implies that

$$\frac{\partial p_L}{\partial \sigma^2} > 0.$$

PROPOSITION 2. A mean-preserving spread in the distribution of preferences towards risk, $f(t)$, may increase and cannot decrease the probability of a lapse. ◄

PROOF:

1. The probability of a lapse is given by

$$p_L = \int_{t^*}^{t} f(t)dt. \tag{4}$$

2. The tipping value t^* is invariant with respect to changes in $f(t)$.
3. The density $f(t)$ in the right tail of the distribution beyond t^* cannot decrease and may increase as a consequence of a mean-preserving spread.

Turning to social costs, let i denote the cost of imposing sanctions, where

$$i = i(p,c), \; i_1 \geqslant 0, \; \text{and} \; i_2 \geqslant 0.$$

Lapses occur with probability p_L, as defined explicitly above, where

$$p_L = p_L(p,c), \; p_1 \leqslant 0, \; \text{and} \; p_2 \leqslant 0.$$

Lapses create social costs, denoted k. A simple model of deterrence minimizes the expected costs from lapses and the cost of avoiding them:

$$SC = p_L(p,c)k + i(p,c). \tag{5}$$

PROPOSITION 3. If the cost of incrementing the sanction is at least as great as the cost of incrementing the enforcement probability, then optimal deterrence of lapses is achieved when the sanction is applied with probability 1. ◄

PROOF:

1. Consider an incremental decrease in c and an incremental increase in p, such that pc remains constant. By assumption, $i(p,c)$ has not increased and may have decreased.
2. The decrease in c and corresponding increase in p is a mean-preserving compacting of the distribution. Proposition 1 implies that p_L has decreased.
3. The preceding steps and equation (5) imply that SC has decreased.
4. Optimality requires continuing this process until p reaches its upper limit of one.

Model of regret

Now I expand the model to allow choices to be influenced by expected regret. Expected regret is defined by

$$ER = - \int CE(t_1) f(t_1) \, dt_1. \tag{6}$$

The decision maker's utility function is defined by $w(CE(t_0),ER)$, where $w_1 > 0$ and $w_2 < 0$. Normalize w so that not acting has a value of zero: $0 = w(0,0)$. Consequently, the decision maker acts when $w > 0$, and the decision maker does not act when $w < 0$. The tipping value in the model of regret, denoted $t\sim$, is defined by $0 = w(CE(t\sim),ER)$.

The following proposition is easily proved:

PROPOSITION 4. An increase in expected regret results in fewer lapses.◄

PROOF:

1. Fully differentiate $0 = w$ to obtain

$$\frac{\partial t\sim}{\partial ER} = \underbrace{- (w_2 / w_1 \; CE')}_{-\quad -\quad +\quad +}$$

   The tipping value thus increases.
2. An increase in tipping value results in fewer lapses by equation (4). (Substitute the tipping value $t\sim$ for t^* in this equation.)

Now I turn to the consequences of regret for optimal deterrence.

PROPOSITION 5. An increase in the subjective weight given to expected regret can cause the optimal expenditure on deterrence to increase or decrease.◄

PROOF:

1. First consider expenditure on p. Optimal deterrence minimizes SC as defined by equation (5). At the optimum,

$$0 \geqslant k(\partial p_L/\partial p) + \partial i/\partial p.$$

   The change in weight given to ER by w causes a change in $\partial p_L/\partial p$. If this term increases, then the second order conditions imply that expenditure on the sanction should be reduced to achieve optimal deterrence, and vice versa.
2. I proceed to show that the sign of $\partial p_L/\partial p$ can be $+$ or $-$. By equation (4),

$$\partial p_L/\partial p = -f(t\sim)(\partial t\sim/\partial p).$$

   The change in this value caused by the shift in w is indicated by

$$\delta[\partial p_L/\partial p] = \underbrace{-(\partial t\sim/\partial p)f' \; \delta t\sim}_{\text{responsiveness effect}} + \underbrace{-f(t\sim)\delta(\partial t\sim/\partial p)}_{\text{density effect}}.$$

3. Now I find signs for the responsiveness and density effects. Expenditure on deterrence increases the tipping value $t\sim$. The tipping value $t\sim$ is in the right tail of the distribution by assumption. The shift in the utility function w also increases the tipping value $t\sim$. Hence,

$$\underbrace{-(\partial t\sim/\partial p)f' \; \delta t\sim}_{-\;+\quad -\quad +} > 0.$$

4. The tipping value $t\sim$ is defined by $0 = w(CE(t\sim),ER)$. Fully differentiate to obtain

$$\frac{\partial t\sim}{\partial p} = -\underbrace{\frac{w_2}{w_1}\frac{\partial ER}{\partial p}}_{-\ -\ +}.$$

By assumption w_2, which is negative, decreases due to the change in w. Hence $\partial t\sim/\partial p$ increases. Thus,

$$\underbrace{-f(t\sim)\delta\ (\partial t\sim/\partial p)}_{-\quad +\quad +} < 0.$$

5. Combining the two preceding steps implies that $p_L/\partial p$ can increase or decrease, depending upon whether the responsiveness effect or the density effect is larger.
6. Repeat steps 1–5, substituting expenditure on c for expenditure on p.

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