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ON THE BEHAVIORAL ECONOMICS OF CRIME

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Abstract

This paper examines the implications of the brain sciences' mechanistic model of human behavior for our understanding of crime. The rational crime model is replaced with a behavioral approach, which proposes a decision model comprising cognitive and emotional decision systems. According to the behavioral approach, a criminal is not irrational but rather 'ecologically rational', outfitted with evolutionarily conserved decision modules adapted for survival in the human ancestral environment. Several important cognitive as well as emotional factors for criminal behavior are discussed and formalized, using tax evasion as running example. The behavioral crime model leads to new perspectives on criminal policymaking.

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1 Introduction

Two schools of thought predominate in the academic study of criminal law. The traditional school—that of criminal law purists—is mired in philosophical debates about abstract criminal categories (see, e.g., Fletcher, 2000). The rational-crime school, exemplified by Becker’s (1968) seminal work, replaces unfounded philosophical assumptions of moral rationalism (Hume, 1751) with folk-psychological assumptions of economic rationality. The school’s psychological assumptions—in particular, that the criminal’s decision is based on a fully rational cost-benefit analysis—provide useful insights into incentives but give inaccurate predictions for a wide range of criminal behaviors (Garoupa, 2003).

Meanwhile, crime continues to impose enormous costs on society. For example, Anderson (1999) pegged the annual burden of crime in the US at over \$1 trillion (€800 billion). These costs are thus not at all trivial, and not unique to the US either. Governments worldwide share a keen interest in the efficient reduction of criminal activity.

Of relevance in this regard are recent developments in behavioral economics, psychology, and neuroscience, which are cultivating a new paradigm of human behavior that may provide more accurate predictions of criminal behavior and more effective recommendations for criminal policymaking. Applying this new behavioral paradigm to the economic study of crime is the task of our paper.

This paper is organized as follows. Section 2 characterizes the rational crime model. Section 3 introduces a behavioral crime model that allows for bounded cognition and emotionality, based on the view that (criminal) behavior emerges from the interaction between cognitive and emotional brain systems. More specifically, Subsection 3.1 will focus on cognition, discussing the role of heuristics and phenomena like faulty risk assessment and hyperbolic discounting. Next, Subsection 3.2 will address the role of emotions in behavior, concerning the motivation of reciprocity, the internalization and enforcement of norms, and the sympathetic effects of social ties. The human brain’s ‘ecologically rational’ decision systems—adapted for reproductive fitness in the ancestral human environment—generate behavior that diverges significantly from the predictions made by the rational crime model of *homo economicus*. Policy implications are indicated throughout Section 3, using tax evasion as a running example, while more extensive recommendations are outlined in Section 4. This concluding section also recommends a reevaluation of the criminal law’s notions of responsibility and punishment.

2 The rational crime model

This section briefly characterizes the standard economic model of crime, which applies the rational-choice assumptions of expected-utility theory to criminal behavior and crime regulation.¹ Given the existing crime-regulation regime y , the rational criminal is sup-

¹ Perhaps a more conventional term than ‘crime regulation’ is ‘crime enforcement’. We prefer the more general term regulation, since it allows for the non-coercive aspects of some crime policies.

posed to choose his level of criminal activity or criminality x in line with the maximization of expected utility $R(x; y)$:

$$R(x; y) = (1 - \pi(x; y)) \cdot v(x) + \pi(x; y) \cdot v(p^*(x; y)) = v(x) - \pi(x; y) \cdot p(x; y) \quad (1)$$

with v measuring utility, π the probability of being arrested and convicted for x , and p^* denoting the punishment in that case; $p(x; y)$ at the end stands for the utility differential between the state of not being punished and the state of being punished, that is, $v(x) - v(p^*(x; y))$.² Assuming differentiability and strict concavity of R , a maximum with respect to x follows from the first-order condition:

$$R_x = v_x - (\pi_x p + \pi p_x) = 0 \quad (2)$$

where subscripts indicate first-order derivatives. The resulting choice of $x^*(y)$ is the optimal criminality level for the rational criminal given crime-regulation regime y .

Generally speaking, crime results in disutility not only to the victim but also to other individuals, even those with little or no direct relationship to the crime. A publicized burglary, for example, might induce the neighbors to take costly precautionary measures against future burglaries—installing burglar alarms, for instance. Let the disutility or harm caused by the externalities of $x^*(y)$ —which include the victim's disutility—be denoted by $H(x^*(y))$. Consequently, given regulation regime y , the social harm caused by the criminal may be represented by:

$$H(x^*(y)) - v(x^*(y)). \quad (3)$$

Thus, a given criminality level x is taken to be socially harmful if the benefit to the criminal is less than the cost to those affected by the crime, that is, if it imposes a net cost on society [$H(x^*) - v(x^*) > 0$].

If the relevant authorities are interested in reducing the social harm from crime, they may do so by manipulating the crime-regulation regime y . Changes in y will impact the choice of the criminal through $x^*(y)$. Accounting for the cost of crime regulation—which will be denoted by $c(y)$ —and assuming strict convexity of both the social harm expression and the cost function with respect to y , the optimal crime-regulation regime, y^* , obtains where the marginal benefit of a further reduction in social harm equals the marginal cost:

$$H_y - v_y + c_y = 0 \quad (4)$$

Because increased deterrence imposes increased costs, the socially optimal crime-regulation regime allows some social harm from crime to remain.

Our simplified analysis has intentionally ignored several important issues. First, we have referred to an unspecified criminal act x and a one-dimensional crime-regulation regime

² Note that p^* may include the return of money or goods that are no part of 'punishment' in the legal sense (e.g., imprisonment).

y, whereas in reality various criminal opportunities are available and a crime-regulation regime comprises multiple policy instruments. Second, we have neglected the crime-regulation regime's fixed costs, which might be a further reason that some social harms are not categorized as crime. Third, a positive analysis of a particular society's regulation regime cannot simply assume social welfare maximization as the only policy criterion because it may conflict with the interests of the involved policymakers. History offers plenty of examples of laws criminalizing acts that are difficult to classify as socially harmful—consider the prohibition of political activity, for instance. Other examples of potential political distortions of criminal-law regimes include mandatory prison sentences for drug users benefiting a politically powerful prison industry (Rothman, 2003) and liberal asset-forfeiture laws padding the budgets of local police departments (Miller and Selva, 1997).

Before delving into the behavioral approach to crime, let us make one extension to the rational crime model, related to inter-temporal decision making. A rational actor will take into account any future effects of criminal behavior. Suppose, for convenience, that life can be split up into two periods, where an individual is 'young' in the first and 'old' in the second. In both periods s/he has 1 (divisible) unit of labor that can earn a wage w if fully supplied to the labor market. In the first period s/he can allocate this unit between crime ($0 \leq x \leq 1$) and work ($1-x$). The return on crime is assumed to be 1, while for work it is assumed that $w \leq 1$. In the second period—the actor being too old for crime—labor is fully supplied to the market. The individual knows, however, that job opportunities and thus wages when old will depend on one's criminal behavior when young. Accordingly, the second-period wage is a function of x ; more specifically, it is assumed that $w(x) = \frac{1}{2}w(1-x^2)$. Thus, the more the individual gives in to crime, the faster the expected second-period wage decreases, as the derivative w_x decreases in x (note that $0 \leq w(x) \leq 1$). For further simplicity, we assume utility to be linear in earnings and ignore the expected disutility of getting caught and punished (the second term in eq. (1)). Expected utility can then be written as:

$$R'(x) = x + w(1-x) + \frac{1}{2}w(1-x^2)/(1+r) \quad (1')$$

where r denotes the discount rate. Maximization of $R'(x)$ leads to the rational individual's optimal criminality level:

$$x' = (1-w)(1+r)/w. \quad (2')$$

Crime will be committed if crime pays—that is, if $w < 1$. The optimal criminality level will decrease as market wages w increase or as the discount rate r decreases—that is, the more the individual takes the future into account. We will devote further analysis to this extension in Section 3.1.3 below.

Irrespective of extension or complexity, the rational crime model's basic message remains that the rationally expected benefits and costs of crime will determine criminality. Although the rational crime model helps explain many crime phenomena (Levitt and Miles, 2006; Matsueda et al., 2006), some fundamental problems exist with its ability to

predict criminality levels. Data on tax evasion and tax compliance, for example, suggest that taxpayers systematically violate the predictions of the rational crime model. Specifically, the tax regimes of many societies impose negligible expected costs for evasion, yet most people pay their taxes (Andreoni et al., 1998). Meanwhile, advances in the behavioral sciences indicate that the rational crime model's foundational assumptions do not accurately reflect human decision processes. The subsequent two sections examine this point and its consequences for the modeling of crime.

3 A behavioral approach to crime

Although the rational crime model rightly emphasizes the criminal's responsiveness to incentives, accumulating evidence in the behavioral sciences—including behavioral economics, psychology, and neuroscience—indicates important weaknesses in its modeling of criminal behavior. In this section we will discuss these behavioral findings and how they can be incorporated into a behavioral-economic model of crime.

Existing literature in behavioral law and economics highlights various heuristics and biases of decision-making (e.g., the availability heuristic and overconfidence) as well as social preferences (like inequity aversion) and makes policy recommendations based on those quirks (Jolls et al., 1998; Korobkin and Ulen, 2000; Sunstein, 2000; Tor, 2008). A behavioral-economic approach to criminal law is also emerging (Garoupa, 2003; Jolls et al., 1998; McAdams and Ulen, unpublished).³ Jolls (2005), for instance, notes the availability heuristic and recommends that parking tickets be large, prominent, and gaudy; the public salience of the ticket, she reasons, will increase deterrence of parking violations.⁴ Prescott and Starr (2006) worry that jury sentencing can be skewed by anchoring effects imposed by statements of the parties. There are many similar examples (see McAdams and Ulen, unpublished, and sources cited there).

A systematic weakness in this line of papers, in our view, consists in their lack of a unifying psychological theory under which to subsume their ideas about human behavior. A helpful perspective in this respect is provided by evolutionary psychology. Evolutionary psychology assumes that these so-called quirks in human decision-making are the (side) effects of evolutionary adaptations; they are 'ecologically rational' in the sense that they are specially designed to solve particular fitness-related problems (Cosmides and Tooby, 1994; Gigerenzer, 2005; Smith, 2007; see also Frank, 1988). Meanwhile, neuroscience, neuropsychology and neuroeconomics are providing empirical support for the view that the human brain is the product of natural selection and that its evolved structures influence thought, emotion, personality, and behavior (see, e.g., Camerer et al., 2005; Glimcher et al., 2009). These insights have been applied to the law with promising results (e.g., O'Hara, 2004).

³ Some psychological studies have rendered into question the importance of availability, anchoring, and probability errors for decision-making in the field (Gigerenzer, 2005). For example, according to Cosmides and Tooby (1996), most studies showing probability errors fail to recognize the frequentist nature of the human statistical interface.

⁴ But see our discussion of shaming penalties in section 3.2 below.

In our analysis we will therefore treat people as boundedly rational, being motivated by emotions as well as cognition. Analytically, this approach conceptualizes criminal behavior (B) as the product of a dual process of cognition (C) and emotion (E):

$$B(x) = f(C(x), E(x)) \tag{5}$$

where x refers to the chosen criminality level, and $C(x)$ and $E(x)$ represent the respective cognitive and emotional components of the criminal's decision-making process. Cognition refers to the information-processing and support machinery recruited by the brain for instrumental decision-making and general problem-solving (Geary, 2005). Emotions are specialized brain modules evolved to solve specific adaptive problems, such as fear in response to a predator and jealousy in response to an adulterer (Tooby and Cosmides, 1990). Cognition and emotion can be conceptualized as quasi-independent processes acting on the same stimuli, but with important differences in speed and quality of signal extraction. Whereas the former produce relatively slow and deliberative responses, the latter generate 'quick and dirty' prewired responses (LeDoux, 1998). We will not explicitly model this cognition-emotion time differential, but one should note it to be a potentially important simplification.

It should be noted at the outset that discussing cognitive factors first is in a way misleading; cognition and reasoning evolved long after the emotions (Geary, 2005). Emotion and cognition are under the control of separate and partially independent systems, with emotion having primacy over cognition (Zajonc, 1980). It is thus more accurate from an evolutionary standpoint to say that the 'quick-and-dirty' emotional response is the default decision process, and that the deliberative cognitive process is an evolutionary addendum necessary only in certain ecological and social circumstances. This paper is intended primarily for economists, however, and the default model of decision-making in economics is focused on cognitive rationality and ignores emotions. It is convenient, therefore, to begin discussion with cognition.

As with all of the psychological properties described in this paper, it should be acknowledged that prospective criminals may have psychological traits that differ from the rest of the population. For example, criminality might be stimulated if someone experiences relatively little risk aversion. Therefore, existing experimental studies need not be valid for them pending further research showing similar responses (Oldfather, 2007).⁵

In Subsection 3.1, we will discuss those cognitive factors most relevant to crime; in Subsection 3.2, we will discuss relevant emotional factors. We will incorporate these factors into a proposed dual-process model of criminal decision-making. Given the complexity of the problem, the current state of knowledge, and the space available, we can only provide a few illustrations. Policy implications are indicated along the way but will be the

⁵ Note, however, the meta-study conducted by Fr chet te (unpublished) showing that the performance of professionals is similar to that of college students in many experimental games.

main focus of discussion in Section 4. In each subsection, we attempt to relate the behavioral component to the crime of tax evasion.

3.1 COGNITIVE FACTORS

The cognitive component of the behavioral crime model consists of the human brain's general-purpose problem-solving machinery. This interconnected system of information-processing modules includes sensory processing, perception, imagery, attention, memory, reasoning, and problem-solving, as well as the associated support subsystems (Geary, 2005). Generally speaking, these functions are executed in the brain's higher cortical areas and especially in the neocortex. In stark contrast to the specific adaptive functions performed by the emotions discussed in Subsection 3.2, human cognition is distinguished by its flexibility, what cognitive scientists call soft modularity or plasticity; generally speaking, the cognitive system can be recruited to solving any problem the human organism faces (Geary, 2005). For that reason, it is intuitively helpful to conceptualize the behavioral crime model's cognitive component as an approximation of economically rational decision-making.

Notwithstanding its utility for general-purpose problem-solving, though, the human cognitive architecture still shows clear signs of adaptive specialization. In the words of Hagen and Symons (2008), "[t]he brain is not merely a collection of one or more computational devices, but a collection of computational devices that evolved to facilitate or enable reproduction in ancestral environments by manipulating aspects of those environments." We should thus expect the outputs of the cognitive system to be systematically skewed toward decisions that would have been adaptive in the ancestral human environment, even if they are maladaptive in contemporary society (Burnham and Johnson, 2005). As crime scientists, we can expect to observe the effects of these skewed cognitive outputs in criminal behavior.

The cognitive system is complex, and its adaptive structure likely produces innumerable subtle effects on behavior. The less subtle effects have been well-established, however, and a few of them have powerful implications for a behavioral crime model. We will restrict ourselves here to three of them: risk attitudes, loss aversion, and time preferences.

3.1.1 Risk attitudes

Risk assessment is a decision process operative in any choice whether to commit a crime. Apart from the probability that the crime will actually afford gains, each prospective criminal faces a chance that s/he will be apprehended and punished. Efficient crime deterrence thus requires an understanding of how criminals perceive uncertainty and respond to it.

Prospect theory and the extensive experimental evidence supporting it show that human risk attitudes exhibit systematic deviations from expected utility theory (Kahneman and Tversky, 1979). Experimental observation of probabilistic decision making indicates that humans transform probabilities into decision weights—here denoted by $\delta(\pi)$ —that follow

an inverse-S relationship: Subjects exaggerate the difference between zero probabilities and small probabilities, while small probabilities are overestimated and large probabilities underestimated (Tversky and Kahneman, 1992). These non-linear risk attitudes were predicted independently from prospect theorists by evolutionary biologists working on optimal foraging theory (Stephens and Krebs, 1986), which is consistent with this paper's focus on evolved behavioral mechanisms (McDermott et al., 2008). In the context of crime, decision weighting might explain why, on the one hand, people are willing to take chances in a lottery (like committing a crime) and, on the other hand, to overinvest in insurance against highly unlikely bad events (like burglary).

Prospect theory's decision-weight transformations can be formally incorporated into Section 2's rational crime model. Specifically, $R(x)$ in eq. (1) is substituted by:

$$C(x) = v'(x) - \delta(\pi(x)) \cdot p'(x) \quad (6)$$

where primes indicate that outcomes may now be valued differently because in prospect theory they are assumed to be evaluated against a reference point. As a result, initial (follow-up) expenditures on deterrence will have a greater (smaller) effect on criminal behavior than that predicted by the rational crime model. This notion might account for the irrationally high tax-compliance rates given the rarity of audits: people may overestimate those small probabilities of audit. In their discussion of sentencing policy, Harel and Segal (1999) note prospect theory's prediction of risk-aversion toward prospective gains but risk-seeking toward prospective losses due to a diminishing sensitivity towards larger gains and losses. Since criminal punishments are losses—and therefore criminals presumably prefer risky punishments—crime regimes should make the intensity of punishments as predictable (i.e. non-risky) as possible. This recommendation is consistent with the results of a tax evasion experiment reported in Alm et al. (2009), finding that evasion rates were lowest when the probability of audit was clearly and credibly announced before filing.

Also noteworthy in terms of risk attitudes is work referring to the mating challenges faced by human males as winner-take-all markets, which reward risk-taking (Dekel and Scotchmer, 1999). This dynamic predicts that evolution would have selected for greater risk-taking in males relative to females, a prediction borne out by economic experiments (Dekel and Scotchmer, 1999). This risk-attitude differential likely accounts for part of the extraordinary gender gap in criminality (Campbell, 1999).

3.1.2 Loss Aversion

Experimental evidence further supports prospect theory's claim that "losses loom larger than corresponding gains" (Tversky and Kahneman, 1991). In formal terms, this means that the function $v'(\cdot)$ is steeper in the negative relative to the positive domain defined by the reference point. Like risk attitudes, loss aversion can be seen as an ecologically rational cognitive bias predicted by optimal foraging theory (Stephens and Krebs, 1986). Specifically, a realized gain will increase an organism's energy stores, which might ex-

tend longevity, but a realized loss may starve the organism to death or weaken its chances of reproduction. In terms of reproductive fitness, then, losses and gains are asymmetrical. Loss aversion thus fits naturally into an economic model accounting for evolutionary psychology (Aktipis and Kurzban, 2004; see also Carmichael and MacLeod, 2006).⁶

Loss aversion is important for crime regulation because it implies that punishment (perceived as a loss) will impose a greater deterrent effect than that predicted by the rational crime model. In the behavioral crime model, we might account for (empirically calibrated) loss aversion by weighting losses about twice as much as gains; formally: $v'(-z) = -2v'(z)$. As a formal example, consider the decision to evade taxes. Assume that the reference point is set at fully paying one's taxes. Let x stand for the undeclared sum in dollars, $v'(x)$ for the utility gain from x , f for a fine per dollar of undeclared income if convicted, $v'(-fx)$ for the utility loss in that case, and $\delta(\pi(x))$ for the perceived probability of audit (conviction). Then, we can write the prospective evader's decision function as:

$$C(x) = v'(x) - \delta(\pi(x)) \cdot [v'(x) - (-2v'(fx))]$$

Calibrated results suggest that prospect theory predicts rates of tax compliance and evasion far better than expected utility theory (Dhami and Al-Nowaihi, 2007).

Loss aversion is further relevant to the behavioral model of crime in that criminal appropriations may entail net welfare losses even if they involve transfers of goods. On this view, loss-averse attitudes toward property—commonly known as endowment effects (Huck et al., 2005)—induce victims and criminals to assign greater value to possessed goods than to non-possessed goods. Accounting for endowment effects, a transfer of owned property from victim to criminal results in direct destruction of economic value. The associated increase in social harm from crime might justify greater expenditure on crime deterrence. On the other hand, endowment effects might also motivate larger private expenditures on precautions against theft, in which case lower public expenditure would be necessary to deter theft efficiently.

Relevant to both risk assessment and loss aversion is the notion that people value outcomes against some reference point, thereby determining prospectively and retrospectively whether an economic change is a gain or a loss and respond systematically differently between the two (Kahneman and Tversky, 1986). Gain-loss framing is just one example of the significant effects of context on behavior (Smith, 2007). In principle, the prospective criminal's reference point might also be reframable to improve crime deterrence, but present theories provide little guidance in doing so (see Kőszegi and Rabin, 2006). Studies revealing the importance of emotions in framing might indicate future directions (Druckman and McDermott, 2008).

⁶ Further evidence of evolutionary origin comes from primatological studies finding loss aversion and endowment effects in chimpanzees (Brosnan et al., 2007) and capuchin monkeys (Lakshminaryanan et al., 2008).

3.1.3 Time Preferences

Another important source of cognitive bias is that associated with human time preferences. Experiments suggest that humans share a general preference for immediate as opposed to future gains—and more specifically, that future gains are discounted hyperbolically (Ainsley and Haslam, 1992). These results contradict the exponential discounting of standard economic theory (Frederick et al., 2002). Moreover, it can be argued that hyperbolic discounting is an ecologically rational cognitive adaptation, enhancing fitness by forcefully directing attention to immediate concerns in the competitive ecological and social environment faced by our ancestors (Frank, 2005; Kacelnik, 1997).⁷ Intrasexual competition among males may have had an especially strong adaptive impact; as noted, the winner-take-all mating market faced by our male ancestors incentivized impulsive behavior (Wilson and Daly, 2004). In any case, impulsivity is intimately connected with criminality (Utset, 2007).

Hyperbolic discounting can be formalized in Section 2's young-old paradigm by multiplying all terms related to future periods with a fixed parameter $\beta < 1$, thereby weighting the present more heavily than the future. For our simple two-period crime model represented by eq. (1'), this boils down to replacing $R'(x)$ with:

$$C'(x) = x + w(1-x) + \beta[\frac{1}{2}w(1-x^2)/(1+r)] \quad (6')$$

The prospective criminal's optimal criminality level now becomes: $x' = (1-w)(1+r)/(\beta w)$, implying an additional incentive to commit a crime in the young period.

Previous authors have noted that crime deterrence can be improved by accounting for the effects of hyperbolic discounting (Utset, 2007). In fact, many statutes criminalize impulsive behavior, such as running traffic lights, gambling, and crimes of passion (Frank, 2005). Because impulsivity incentivizes some criminal acts, the behavioral approach to crime might improve upon the rational crime model by recommending stronger deterrence measures for impulsive crimes. On the other hand, impulsive acts are often easy to detect and prosecute, so the increased chance of conviction for impulsive crimes might itself increase deterrence (R.A. Posner, 2001). More generally, a government could compensate for our faulty temporal-discounting mechanisms by discouraging impulsive behaviors with immediate gains but delayed costs.⁸ This analysis might justify statutes taxing (or criminalizing) impulsive victimless conduct like gambling, drug use, and prostitution.

The finding of hyperbolic discounting also calls for reevaluation of prison sentencing. For one, it suggests that we reduce the time lapse between commission of and punishment for a crime (Cooter, 1991). Because the costs of a far-off punishment are discounted relative to the immediate gains from the crime, some crimes are committed that might oth-

⁷ As with loss aversion, hyperbolic discounting has been found in other primates (Hayden and Platt, 2007).

⁸ See Camerer et al., 2003.

erwise be deterred in a system of swift justice. Likewise, the tail-end years of longer prison sentences will be heavily discounted and impose relatively little deterrent (Polinsky and Shavell, 1999). A related sentencing problem is that imposed by duration neglect (Kahneman et al., 1997), which suggests that a former convict's ex post evaluation of his/her prison sentence will be impervious to the sentence's duration.

As may already be clear, impulsivity is closely related to emotional decision processes. This relation is especially palpable in the context of addiction. In addiction-related crime, the addict's cognitive and emotional gains and losses are distorted by drug-related psychological effects. Withdrawal symptoms, in particular, can motivate socially harmful activities (Uggen and Thompson, 2003). Other studies have shown that failure to respond to criminal deterrence mechanisms extends even to non-habit-forming drugs like marijuana (Reinarman et al., 2004). Kahneman et al. (1997) argue that hyperbolic discounting and duration neglect are likely responsible for many instances of unsafe drug use. Accounting for these time-related decision effects can assist comprehension and regulation of criminal behavior.

3.2 EMOTIONAL FACTORS

As discussed in Section 3's introduction, we conceptualize behavior as the product of a dual process of cognition and emotion. Recalling the formalization of eq. (5), $B(x) = f(C(x), E(x))$, this subsection deals with the emotional process, $E(x)$. Psychologists have devoted decades of exacting research into the emotions, and there is growing recognition that emotions play a significant role in economic behavior (Elster, 1998; Loewenstein, 2000; Rick and Loewenstein, 2008; van Winden, 2007). But even today, emotion research has hardly left an imprint on behavioral-economic models. This section reviews some of that research and discusses its implication for a behavioral model of crime.

An emotion begins with an elicitor, the stimulus that triggers an emotion's onset. Generally speaking, elicitors are events appraised as relevant for a concern or interest of the elicitee (Frijda, 1986; Oatley and Jenkins, 1996). If the concern is promoted, a pleasurable positive emotion arises; if the concern is thwarted, a painful negative emotion arises. Emotions thus have a direct hedonic quality, what psychologists call valence. Comparative studies indicate that the experience of negative emotions is typically more intense than that of positive emotions (Baumeister et al., 2001). This latter phenomenon is relevant to many aspects of crime modeling, not least crime victimization's tendency to inspire fear, a deeply unpleasant emotion (see Smolej and Kivivuri, 2006).

For basic emotions (like anger and fear), elicitors include situations that recurred throughout our evolutionary history, like conspecific aggression, mating opportunities, the threat of predation, and discovery of sexual infidelity (Tooby and Cosmides, 1990). Recurrent circumstances like these presented specific adaptive problems that invited evolution of specialized brain systems (emotions) to control behavioral responses to them. The behavioral or strategic response motivated by an emotion is known as its action tendency—curiosity's search, for example, or fear's 'flight or fight'. Besides their ac-

tion tendencies, basic emotions are also associated with universally recognizable facial expressions (Ekman et al., 1987).

Whether an action tendency will actually result in its motivated action depends on the influence of further cognitive appraisals regulating the emotional process. Involvement of the cognitive system leads to a more refined contextual evaluation, the contemplation of coping possibilities, and the measuring out and trading off of tangible costs and benefits. Sometimes, the operation of these cognitive factors will result in suppression of the experienced emotion, and sometimes not. Whether or not suppression occurs depends in part on the emotion's intensity, which comprises factors like the importance of the concern involved, the reality and proximity of the eliciting stimulus, the level of arousal, and the degree of unexpectedness (Ortony et al., 1988). Furthermore, the same event may trigger different intensities of emotions in different people, due to the influence of more persistent affective states (traits) like depression or intrinsic emotional dispositions. The impact of the latter can be especially dramatic in the case of brain lesions (see Damasio, 1994).

Aside from suppression, the cognitive system interacts with the emotion system in two other interesting respects: content dependency and affective forecasting. An important example of content dependency is the mood-congruency effect, which refers to findings that subjects in a positive (negative) emotional state retrieve positive (negative) memories more readily (Bower, 1981). The interaction between cognitive and emotional systems thus results not only in state-dependent preferences but also state-dependent beliefs (Bower and Forgas, 2000). Affective forecasting refers to the cognitive system's capacity to anticipate future emotions. Experiments have shown, however, that this capacity is limited; people rarely make accurate predictions of their future emotional states.⁹

In any case, it is emotion rather than cognition that determines the extent to which concerns will be taken into account in the decision-making process. Cognitive calculations are just one input into the decision process and require some emotional arousal to influence behavior (Frank, 1988; Frijda, 1986). Indeed, $C(x)$ presupposes a preexisting emotional state—in tax evasion, for example, a desire for money is assumed. Incidentally, the intensity of the desire for money might be partly responsible for the observed distortion in the perception of probabilities, captured by $\delta(\pi(x))$ in eq. (6). In this subsection, we will ignore these complications and simply assume that $C(x)$ is independent of the emotional states that will be considered.

Incorporating these insights into the dual-process behavioral crime model requires first that we assume a maximum for the criminality level x , which we normalize to 1: $0 \leq x \leq 1$. The implied unitinterval represents the action space for our prospective criminal; see Figure 1. We conceptualize the criminal's cognitive and emotional decision systems as generators of force fields in the action space. Assuming that both $C(x)$ and $E(x)$ are diffe-

⁹ Blumenthal (2005); see also MacAdams and Ulen (2009). People also have difficulty recalling past emotional states (Kahneman et al., 1997).

rentiable functions, the gradient vectors of these functions, $\nabla C(x) = C_x$ and $\nabla E(x) = E_x$, can be used to show the action tendencies or forces on behavior at a given level of x . Figure 1 depicts the case in which cognition (e.g., cost-benefit analysis) motivates the individual to criminality ($C_x > 0$), while emotion (e.g., anticipated guilt) discourages the individual from criminality ($E_x < 0$)—but not completely, as $C_x > |E_x|$. Consequently, in this example, the individual will engage in criminality up to the level x^B , where the cognitive and emotional action tendencies balance, that is, where $C_x + E_x = 0$ (or else $x^B = 1$). This scenario is intuitive inasmuch as criminality is likely to be positive in many cases—most drivers speed to some degree, for example.



Figure 1. Action space with action tendencies as forces.

In the case of tax evasion, the marginal utility of evasion will diminish with more evasion ($C_{xx} < 0$), while the marginal disutility of feeling guilty is likely to increase ($E_{xx} > 0$). Note that, under the simple assumptions made, the decision process is equivalent to the maximization of $B(x) = C(x) + E(x)$.

Thus far, we have made no distinction between various emotion types, notwithstanding that emotions are psychological modules that operate quasi-independently (Ekman, 1999). As it is beyond the scope of this paper to give a comprehensive account of emotions, we discuss only those that seem to be particularly important in the context of crime. As a preliminary matter, it should be noted that the same stimulus can evoke multiple emotions in the same subject, and that these simultaneous emotions can either reinforce or counteract each other. The aggregate outcome of the different action tendencies involved—the emotions' aggregate force in the action space—may be strong enough to tip the criminality decision away from that motivated by the cognitive system. In this respect, emotions can compensate for weaknesses in the cognitive system's bounded rationality and thereby assist good decision making (Muramatsu and Hanoch, 2005).

The following subsections focus on the relevance of three important emotion types for criminal behavior. Subsection 3.2.1 discusses anger and negative reciprocity. Subsection 3.2.2 discusses social norms and their emotional enforcement mechanisms, shame and guilt. Subsection 3.2.3 ends with a discussion of sympathy and social ties. In each subsection, we further formalize these emotions in the behavioral crime model.

3.2.1 Anger and altruistic punishment

Anger is an emotion with a negative hedonic value elicited by the appraisal that interests are frustrated. The intensity of anger depends on, among other factors, the intentionality

of the frustration, the proximity of stimulus, and the stakes involved. While uncontrollable natural events like blizzards can elicit anger, we are interested in anger's elicitation in response to harm inflicted by human agents. This harm can arise from physical violence as well as verbal abuse or shirking of responsibilities. A perpetrated injury can elicit anger not only in the victim but also in bystanders that have no prior relationship with either injurer or victim (Haidt, 2003).

Anger's action tendency, simply put, is retaliation. Anger motivates the elicitee to reciprocate harm with harm, even if that reciprocation is (potentially) costly. This phenomenon—of costly negative reciprocation—is known as altruistic punishment (Fehr and Gächter, 2002). Through its action tendency to altruistic punishment, anger exerts a prosocial influence on social environments by deterring potential injurers with the threat of retaliation. In light of the selective benefits derived from negative reciprocity, it appears that anger is an evolved psychological device specifically adapted for the punishment of free riders (Price et al., 2002; Trivers, 1971). Meanwhile, experiments with public-goods games have shown that human subjects are quite willing to punish defectors even at direct cost to themselves, and that punishment of defectors is more effective than reward of cooperators (Fehr and Gächter, 2002). Note that it is the cognitive anticipation of angry retaliation, part of $C(x)$, that serves as a crime deterrent.

Anger's urge to retaliate has served an important deterrent purpose in pre-legal societies, but it has since been mostly replaced by the criminal law, an institution which is (potentially) more efficient in producing social welfare (Rubin, 2008). This is partly due to the fact that deterrence of social harms is a public good; angry retaliation, as a private measure, may therefore be undersupplied (Yamagishi, 1986). Moreover, emotions like anger are unpredictable and volatile, making it difficult to balance marginal benefits and costs therefrom. With the public institution of criminal law, the costs of enforcement can be more equally distributed, and punishments can be better fine-tuned.

Nonetheless, hard-wired emotions cannot be completely ironed out by law, so anger's action tendencies—and their coincident deterrent threat—remain. This threat of retribution directly reduces the expected utility from some crimes. The upshot for crime regulation is that those criminal actions that also elicit anger's action tendencies—physical assaults, for instance—might not require as much deterrence as the rational crime model would predict. Tax evasion, for example, as a defection on societal public goods, might also elicit anger among non-kin (Alford and Hibbing, 2004). Noting the prosocial benefits of altruistic punishment, Smirnov (2007) goes as far as to recommend government policies that actively facilitate altruistic punishment of social offenders by private citizens.

On the other hand, some crimes are so complex, hidden, or otherwise divorced from interpersonal interaction that they will not easily elicit outrage regardless of their actual social cost; insider trading and other white-collar crimes likely fall under this category. Not coincidentally, white-collar crimes are the product of a technological environment that did not have an analogue in our evolutionary past, and therefore perpetration of these

crimes does not present a social stimulus that would easily elicit our anti-free-rider psychological device. In cases like these, policymakers cannot rely on anger to threaten offenders with retribution.

But anger has a dark side. Aggressive action tendencies can induce criminal acts and retaliatory punishments may escalate (Hopfensitz and Reuben, 2009). Moreover, recent evidence from experiments in some cultures indicates a desire for antisocial punishment—that is, some people are willing to expend resources to punish individuals who behave prosocially (Herrmann et al., 2008). This particular study found, however, that rates of antisocial punishment decreased as appreciation for the rule of law increased. These and other socially harmful effects partly explain why the law has sought to displace anger's social function.

In modern polities where legal infrastructures are firmly established, the social costs of violent retribution are often regarded as greater than the social costs of conviction and punishment (Rubin, 2008). This recognition is reflected in penal codes criminalizing unprovoked physical violence. In those cases where a social harm's deterrence costs are greater than its social costs, the deterrent effect of anger continues to serve a potentially welfare-enhancing social function. Intentional emotional harm through verbal acts—like insults—may constitute a case in point. Given the overlap in neural responses between physical and mental injury (Eisenberger et al., 2003), insults may be considered socially harmful. But the costs of deterring insults through the criminal law are presumably far greater than the costs generally imposed on the victim of the insult. Experimental evidence suggesting that verbal retribution may forestall other harmful acts also justifies the legality of insults (Xiao and Houser, 2005).

To illustrate how to incorporate anger into the behavioral crime model, we return to the example of tax evasion. Anger can be directed at governments as well as individuals, while the history of tax revolts shows that taxation can evoke strong emotional responses. This historical evidence is corroborated by experimental findings from the power-to-take game, a game related to the ultimatum game (Bosman et al., 2005; Bosman and van Winden, 2001). In the power-to-take game, participants are randomly and anonymously paired. The proposer can claim a percentage of the responder's income, which is called the take rate. The responder is then given the opportunity to destroy any proportion of his/her own income, which is then lost for both players. The responder can thereby reduce how much is transferred to the proposer. Various studies with power-to-take have shown that anger plays an important role in the responder's decision to destroy, and that the difference between the take rate and the expected take rate correlates with the anger that is experienced (Bosman et al., 2005).

This intuitive finding—that anger correlates with frustration of expectations—serves as the empirical basis for our incorporation of anger into the behavioral crime model. Assume that the (quasi-independent) brain system involved in experienced anger can be represented by a function E^a . Also assume that the tax to be evaded is appraised as too

high. The relevant action space is made up by the feasible amount of non-declared income, y^{ND} . Normalizing the maximum (which is total income) to 1, the action space is as illustrated in Figure 1, with y^{ND} substituted for x . In this case, however, the emotion system's action tendency E^a_{yND} reinforces the cognitive system's action tendency C_{yND} ; because the tax rate is appraised as too high, anger motivates refusal to pay taxes. The force exerted will depend on the intensity of the emotional response, which we take to be positively dependent on the difference between the income tax rate t and the expected tax rate t^e , and negatively dependent on the amount of non-declared income y^{ND} . Individual heterogeneity (anger-proneness) is allowed for by introducing a trait parameter θ^a (≥ 0). Thus, we can write: $E^a(t - t^e, y^{ND}; \theta^a)$. In terms of Figure 1, the gradient of this function can be exemplified by: $E^a_{yND} = \exp[\theta^a(t - t^e - y^{ND})]$, which increases in the tax rate differential and decreases in the level of tax evasion, allowing for a trait effect. Due to the experienced anger invoked by the tax rate, evasion increases up to the level where $C_{yND} + E^a_{yND} = 0$ (or $y^{ND} = 1$).

In the foregoing example, we focused on an experienced emotion. When making a decision, though—including the decision to evade taxes—people might also anticipate and take into account future emotions that turn on the decision. Because of their special significance in the context of crime and norm-related behavior, especially in terms of affective forecasting, the next subsection directs attention to the emotions of guilt and shame.

3.2.2 Shame, guilt, and social norms

As moral emotions, shame and guilt facilitate prosocial behavior (Haidt, 2003). Both are 'self-reproach' emotions (Ortony et al., 1988), involving a feeling of discomfort that is triggered by the violation of values or norms. The more serious the perceived violation, the greater the emotional intensity and the more painful the emotional experience. A speeding ticket, for example, might result in mild embarrassment, while a drunk-driving arrest could activate intensely uncomfortable feelings of shame.

Although shame and guilt show many similarities and are often elicited simultaneously, there are important evolutionary and behavioral differences (Haidt, 2003; Tangney and Dearing, 2002). Shame evolved as a social defense mechanism to motivate retreat or concealment or to signal submission in the presence of a social threat like ostracism (Gilbert, 2003). Guilt evolved from a care-giving system related to a concern for not hurting others and maintaining reciprocal social relations (Gilbert, 2003; Trivers, 1971). Shame generally requires that a norm violation be publicly observable, while guilt does not. This generalization is complicated, however, by the fact that people can experience shame even in private, while the experience of guilt can vary depending on the interpersonal context (Tangney et al., 1996). A key distinction is the focus of attention. While guilt is elicited by recognition of a singular, externalized wrongful act, shame is elicited by the perception of oneself as being an intrinsically 'bad person' that failed to measure up to society's normative standards (Haidt, 2003). Consistent with this distinction, guilt's action tendency involves apologizing to or compensating the victim of the wrongful act,

while shame's action tendency involves social retreat or submission. As both of these emotions have a negative hedonic value, humans have an intrinsic motivation to avoid them. Most humans therefore have an intrinsic incentive to abide by social norms.

Experimental evidence regarding repeated social dilemmas and power-to-take games shows that shame and guilt can diminish excessive punishment and exploitative behavior (Hopfensitz and Reuben, 2009; Reuben and van Winden, 2008). In a tax evasion experiment, Coricelli et al. (2007) found that inducing shame in evaders by publicizing their photographs resulted in high compliance rates relative to control treatments. Becker and Mehlkop (2006) present evidence from survey data that the degree of internalization of social norms (law obedience) is associated with reduced criminality levels (among which, intended tax fraud). This preliminary empirical work confirms the importance of shame and guilt in criminal behavior and invites further investigation.

To illustrate how guilt and shame can be incorporated into the dual-process model, we return to our example of tax evasion. Assume that the tax regime is appraised as legitimate. The anticipation of guilt and/or shame will exert some negative force on the underreporting of income, as illustrated by the emotion system's action tendency in Figure 1. Assume that guilt is the focal anticipated emotion when contemplating underreporting and escaping detection (with probability $1-\pi$), while shame is focal when contemplating underreporting and subsequently being caught (with probability π) (Erard and Feinstein, 1994). As with anger, guilt and shame are represented by differentiable functions: E^g and E^s , respectively (where, for simplicity, we neglect forecasting errors). Furthermore, let the intensity of these emotions be positively related to the amount of non-declared income via the trait parameters θ^g and θ^s . Then, the force exerted by these emotions as anticipated while contemplating the underreporting of y^{ND} can be exemplified by the gradient vectors: $E^a_{y^{ND}} = -(1-\pi) \cdot [\exp(\theta^g y^{ND}) - 1]$ and $E^s_{y^{ND}} = -\pi \cdot [\exp(\theta^s y^{ND}) - 1]$. Allowing also for the experience of anger as formalized above, tax evasion will take place up to the level where: $C_{y^{ND}} + E^a_{y^{ND}} + E^g_{y^{ND}} + E^s_{y^{ND}} = 0$ (or y^{ND} becomes either 0 or 1). Here, we have implicitly assumed that the operative social norm is to fully declare one's income. In some cases, people may be influenced by reference groups that find some underreporting justified. Denoting the social norm's prescribed tax compliance as y^{NDn} , guilt and shame will only be anticipated if $y^{ND} > y^{NDn}$.

More generally, because they deter social-norm violations rather than legal-norm violations, shame and guilt operate in tandem with the law's deterrent effect only when social norms overlap with legal norms—that is, when social norms sanction the social harms targeted by legal norms. In well-functioning democracies where people feel committed to policies, legal norms may not only reflect social norms but also strengthen them (Licht, 2008). Note, however, that enforcing a social norm intrinsically through guilt and shame can be more efficient than enforcing an identical legal norm through the extrinsic threat of criminal punishment. Law enforcement can be exceptionally costly, after all, and inter-

nalized social norms enforce themselves.¹⁰ A social welfare perspective argues for the legal establishment of an optimal moral system enforced by guilt and shame that maximizes social welfare (Kaplow and Shavell, 2007).¹¹

Notwithstanding the potential effectiveness of informal shaming penalties, there are at least three arguments against using the law to facilitate them. First, there is significant variance between individual criminals in the disutility imposed by shaming—indeed, some people are shameless (E. Posner, 2001). This emotional-trait variance renders the penalty too high for some and too low for others in terms of efficient punishment. Second, a penalty like social ostracism oftentimes imposes a permanent negative impact on the criminal's future socio-economic prospects, which can lead to serious social costs through loss of productivity. Third, where legal norms overlap with social norms, publicizing criminal violations may damage the community's image of public compliance with a norm, thereby weakening the social norm's overlapping deterrent effect. These concerns likely explain why shaming penalties have been abandoned in many jurisdictions, and why some governments even take affirmative steps to protect the privacy of suspected and convicted criminals.

3.2.3 Empathy, sympathy, and social ties

Another important emotional trait in the context of crime is empathy, which refers to the conscious, vicarious sharing of another agent's emotional experience (Eisenberg and Strayer, 1990; Singer, 2009). Social psychologists conceptualize empathy as having three characteristics: (1) an emotional response to a target person that entails sharing the person's (imagined) emotional state; (2) a cognitive event in which the target's perspective is taken; and (3) recruitment of monitoring mechanisms to maintain recognition that the emotion is empathized rather than directly experienced (Lamm et al., 2007). The third property is consistent with empathy's requiring linkage, but not confusion, between self and other (Decety and Hodges, 2006). By helping people make inferences about others' emotional states, empathy facilitates both cooperation and deception in social environments. These benefits appear to have warranted its evolution (Preston and de Waal, 2002; Silk, 2007).

Empathy may induce helping behavior—for example, to relieve oneself of a sad feeling caused by someone else's distress—but is not sufficient for caring behavior; that requires sympathy (Cialdini et al., 1997; Maner et al., 2002). Emotion scientists conceptualize sympathy as an affective response often stemming from empathy that consists of concern for a target person's well-being and a concordant motivation to alleviate the tar-

¹⁰ See Section 4 below.

¹¹ Aside from the violator's own emotions, the emotions of others may play a role as well. For example, emotions like indignation or contempt can motivate punishment by others (e.g., ostracism) and thereby induce social-norm compliance when behavior is observable. On the willingness of bystanders to punish 'defectors', see Ule et al. (2009). The deterring effect may not only be related to anticipated costs (captured by C) but, in empathic people, also to the sharing of feelings, especially in close relationships (see next subsection).

get's suffering (Wispé, 1986). Sympathy is associated with affinity, agreement, and association with the target (Decety and Chaminade, 2003). It appears that sympathy evolved as the positive-reciprocity complement to anger, motivating humans to reward each other for prosocial contributions to each other and to the community (Silk, 2007; Trivers, 1971). Empathy and sympathy are important for a crime model because they can discourage harmful behavior by injurers and motivate helping behavior to victims. Indeed, psychopathic personalities are commonly characterized by an incapacity to feel empathy (Blair et al., 1997). This condition appears to be associated with measurable brain malformation (Raine et al., 2000).

Sympathy has been formalized in the economics literature as a *social tie*, a weight attached to the utility of other people (van Dijk and van Winden, 1997; see also Levy and Peart, 2009). In the social ties model, beneficial interaction with a target person is assumed to cultivate a positive social tie with him/her—that is, a positive weight for the concerns of the target. To the extent that interactions between individuals are experienced as positive, feelings of affinity, agreement, and association are likely to grow as well. The opposite is also true—namely, that maleficial social interaction can cultivate a negative social tie, resulting in feelings of antipathy, dislike, and dissociation with the target. This latter case—of a negative social tie—describes not a state of sympathy but rather a state of hatred which may motivate hurtful behavior or even cruelty (Taylor, 2009).

Recalling eq. (5), a social tie for subject agent i and target agent j can be formalized by an interdependent (extended) utility function $B_i^*(x)$, specified as:

$$B_i^*(x) = B_i(x) + \alpha_{ij}B_j(x)$$

where α_{ij} denotes the social tie and, as above, x indicates the criminality level contemplated by i . Thus, depending on the magnitude of the social tie (α_{ij}), j 's utility looms more or less strongly in i 's decision function. As noted, a negative α_{ij} is possible and implies that predicted harm to j bodes in favor of i 's decision. This model helps explain, for example, both administrative corruption (the result of a positive social tie) and premeditated murder (the result of a negative social tie). More generally, one can write:

$$B_i^*(x) = B_i(x) + \sum_j \alpha_{ij}B_j(x) \tag{7}$$

where the summation is over all other individuals from i 's community (indexed by j) with whom i maintains a tie. Crime can affect many people, but it usually affects people with which the criminal has weak social ties. This model predicts a preference for crimes that generate positive externalities and avoid negative externalities for those with whom the criminal maintains positive social ties, and vice versa for those with whom negative social ties are maintained. Aside from its intuitive sensibleness, the social ties model is consistent with data obtained from several experiments (van Winden et al., 2008b).

The inclusion of sympathy has substantial consequences for the behavioral crime model. An individual who experiences sympathy for a target person will not only be significantly constrained in inflicting pain on the target but will also be willing to help the target. Consequently, a socially cohesive neighbourhood characterized by many positive social ties is likely to enjoy a robust provision of voluntary public goods, including greater safety. Sympathy precludes the desire to commit crimes among neighbours while the voluntary provision of altruistic punishment enforces conformity among deviants and entrants. This hypothetical neighborhood contrasts starkly with socially anomic neighbourhoods characterized by negative ties, in which people are unwilling to help and even willing to exploit each other for private gain.

It must be cautioned, however, that government interference with social dynamics, if improperly implemented, can have the opposite of its intended effect. Just as monetary compensation can crowd out intrinsic motivations to donate blood, so can government intervention in public good provision interfere with the establishment and maintenance of social ties, generated by social interaction. The policy might thereby crowd out the intrinsic motivation to deter crime provided by the ties (van Dijk and van Winden, 1997; van Winden et al., 2008a; see also Frey, 1997).

As we hope to have shown with sympathy and the other psychological phenomena discussed in this section, the inclusion of emotions in the behavioral crime model need not lead to an incomprehensible amalgam of irrational forces. The advocated behavioral approach treats individuals neither as standard expected utility maximizers nor as unpredictably irrational enigmas, but rather as organisms outfitted with cognitive and emotional decision systems that maximized fitness in the ancestral human environment. Those decision systems have implications for criminal behavior that are, at least in theory, predictable. By establishing a precise framework for targeted empirical study, the behavioral approach can assist with the development of more effective crime-deterrence policies. To this issue we turn next.

4 Implications for crime policy

The behavioral approach to crime, as we see it, conceptualizes crime as the product of a mechanistic brain, inviting discussion of whether it deprives people of a free will. If criminals can be reduced to machines, some ask, how can we legitimately hold them responsible for their crimes? This is indeed an important issue if one endorses the time-honored retributivist justification of punishment, which is based on a just-deserts philosophy (Fletcher, 2000). It is not as important, however, if one takes the consequentialist view that punishment (and crime regulation generally) is an instrument for promoting future social welfare (Greene and Cohen, 2004). We believe that a concept of free will, notwithstanding its significance for legal and moral philosophy, stands in the way of a scientific—and more humane—approach to criminal behavior and its regulation.¹²

¹² See Greene and Cohen (2004) for a careful argumentation.

A more fruitful endeavor, fitting the consequentialist justification of punishment, begins by distinguishing responsibility and deterrability (Deigh, 2008). On this view, a criminal is *responsible* if he physically commits a criminal act, but he is *deterrable* if the threat of punishment can prospectively prevent him from committing that act. These concepts are separable. More precisely, deterrability is a subset of responsibility, as demonstrated by those cases of responsibility without deterrability—that is, where an agent physically performs a criminal act but the threat of punishment imposes negligible negative incentive on him. Some might argue that the mentally ill should be relieved of responsibility for their crimes, while ideological fanatics should remain responsible, even if both types of offenders are undeterrable. This distinction dovetails with our moral intuitions, but from a social-welfare perspective, expending state resources to prosecute and punish an undeterrable ideologue can be as wasteful as prosecuting and punishing a person with mental illness. If no efficient preventative mechanism is feasible (e.g., medication), it would stand to reason to incarcerate the fanatic as if he were mentally ill—not as punishment, but as a protective measure for the rest of society. On this view, the concept of responsibility should be retained only in a technical sense, making the physical perpetrator of a criminal act automatically responsible. This rule would maintain focus on whether and how crime-regulation institutions can enhance social welfare. Deterrability, therefore, would be of central importance. Admittedly, to the extent that individual welfare is (or remains) influenced by retributive beliefs and feelings—for one thing, because people may be reluctant to give up the ‘folk psychology’ of a free will—even a consequentialist approach cannot ignore retribution.

These fundamental and thorny issues aside, the behavioral approach to crime unlocks a new realm of policy reforms grounded in empiricism rather than rationalism (see Chorvat and McCabe, 2004). These reforms move far beyond the rational crime model’s ‘probability of detection and fine’ arguments and target the various cognitive and emotional factors discussed throughout Section 3. Generally speaking, a broadening of the legal community’s understanding of deterrence is advocated, leading to valuable new insights into criminal policymaking.

As illustrated by the case of tax evasion, instead of focusing on policies designed to increase penalties or the objective probability of detection, greater attention should be paid to policies that exploit human risk attitudes and emotions. For example, as the section on risk attitudes explained, increasing audit probability is costly but diminishes in effectiveness beyond some small values. Our discussion of emotional factors, meanwhile, shifts attention away from purely extrinsic motivation to various forms of intrinsic motivation. In the context of tax evasion, for example, one might avoid anger among taxpayers by explicitly relating taxes to benefits (as with earmarked taxes). After all, Adam Smith’s *The Wealth of Nations* refers to avoiding ‘vexation’ as one of the four ‘maxims’ of taxation; although not strictly an expense, the taxpayer would be willing to pay to be redeemed from it (Smith, 1971 [1776], Vol. 2, p. 309). Another strategy could be to strengthen tax morale by, for instance, giving citizens more direct responsibility for tax policymaking (cf. Frey, 1997). Once people feel a moral obligation to pay taxes, emotions like

guilt and shame provide internal incentives for compliance. Moreover, as discussed for the voluntary provision of public goods, direct involvement in policymaking might cultivate strong social ties and the concordant feelings of interpersonal sympathy. Reframing taxes as membership dues in a socially cohesive community may be an important component of broadened efforts to induce greater compliance.

The behavioral approach to crime argues for greater attention to parenting and education.¹³ While emotional dispositions, impulse-control abilities, and norms have a strong genetic component (Geary, 2005), they are cultivated during childhood under the influence of parents and other educators. Basic emotions—like joy and sadness, triggered by rewards and punishments—are exploited to instill self-enforcing norms and values in children, deterring harmful behavior even when the responsible educators are absent. Once norms are internalized, the emotions of guilt and shame help to enforce them. As discussed above, norms and values, but also impulse-control abilities, provide internal mechanisms that can reduce criminal activity and result in substantial public savings on crime-deterrence expenditure. Education has been shown to significantly reduce future criminality,¹⁴ and the instillation of social and moral norms likely accounts for much of this reduction. Strengthening this view is evidence showing a strong association between a nation's level of education and its quality of governance (Rindermann, 2008).

New developments in medicine and neurobiology present another high potential, but also controversial, source of novel policy instruments. Medical treatments may be expanded beyond the scope of drug-related crime to other kinds of offenses, such as those related to aggression. For example, medication might be a desirable replacement for prosecution for an individual with antisocial personality disorder, as imprisonment might impose a negligible deterrent on that individual (Mealey, 1995). Neurophysiological studies have implicated specific neurotransmitters in aggressive behavior, and drugs regulating them should not be far behind.¹⁵ Likewise, serial rapists and pedophiles, plagued by uncontrollable lust feelings, might agree to undergo surgical sterilization in lieu of going to prison (see Edwards and Hensley, 2001). Clearly, these developments raise many ethical issues, but they are likely to lead to novel treatments. Noteworthy in this regard is evidence presented by Marcotte and Markowitz (2009) that about 12 percent of the violent crime drop in the United States over the period 1997-2004 was due to increased use of psychiatric drugs among those with mental illnesses.

Finally, we mention social ties as a potentially important policy instrument. As discussed above in the section on sympathy, local crime might be substantially influenced by the

¹³ A similar shift is advocated in labor economics (Heckman, 2006; Heckman and Masterov, 2007).

¹⁴ Lochner and Moretti (2004) estimate that the social savings from crime reduction associated with high school graduation (for men) is about 14-26 percent of the private return.

¹⁵ See Gregg and Siegel (2001). For example, Naltrexone, also available as an extended-release injection, is an opioid antagonist that blocks the pleasurable effects of morphine, heroin, and alcohol (Tucker and Ritter, 2000). One can readily imagine similar interventions for other addictions, and even for maladaptive behaviors like impulsivity and aggression.

affective bonds between people in local communities. On this view, the ecology in which a prospective criminal operates can have a decisive effect on criminality (see Clarke, 1995). Essential for the development of ties is mutually beneficial social interaction, as in the case of voluntary provision of a local public good. In this vein, Smirnov (2007) recommends that governments facilitate the construction of a social commons sustained by social ties and altruistic punishment. If unsuccessful, though, social interaction can turn sour and give way to negative ties. In this latter case, government intervention may be helpful to redress crime and to stimulate the development of social ties. In any case, policymakers must be wary that political intervention might actually crowd out the intrinsic motivation provided by social ties, making crime deterrence more costly. Any policy in this respect must naturally consider the consequences of social heterogeneity, including ethnic diversity, which are still underexplored (see Pettigrew, 1998).

These proposals for punishment reform, alongside the many other points made in this paper, demonstrate the potentially profound implications of the behavioral approach for criminal-law institutions. Behavioral research in crime theory and crime policy may stand to gain much from further progress in this area. Benjamin and Laibson (2003) are right to note that politicians (and academics) are also constrained by behavioral influences; therefore, any reforms working from behavioral principles should proceed incrementally, experimentally, and with caution (see also Smith, 2007). With these concerns noted, it remains the case that an enlightened criminal law that accounts for behavioral findings may deter social harms more effectively and at reduced costs to society.

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