Recidivism and Uncertainty in Deterrence

Preliminary and Incomplete

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Gregory DeAngelo*
deangelo@econ.ucsb.edu

Gary Charness
charness@econ.ucsb.edu

Michelle Janer
mjaner@email.cudenver.edu

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Abstract

We conduct laboratory experiments to investigate the effects of deterrence mechanisms on recidivism under controlled conditions. Determining rates of recidivism are very difficult to observe in field data since we only observe when an individual is arrested for committing a crime. Moreover, the effect of uncertainty over the enforcement regime can be examined to determine the relationship between uncertainty and recidivism. We use a roadway speeding framing and find that despite the fact that uncertainty yields greater deterrence it also leads to more recidivism and a smaller time interval until an individual recidivates. These results contribute an important relationship between uncertainty and recidivism to the behavioral theory of deterrence research literature.

Keywords: Recidivism, Deterrence, Uncertainty, Enforcement
JEL Classification: K10, K42

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1 Introduction

Deterrence mechanisms – such as the probability of apprehension, fines, and jail sentence length – have been used to prevent individuals from committing proscribed activities. The effect of these mechanisms are theoretically well understood: increases in the expected cost of committing illegal activities will reduce the amount of crimes committed. The concept of deterrence has been examined for some time. In the 18th century Jeremy Bentham argued that crime was the product of the exercise of free will and could be deterred by punishment such that the expected discomfort experienced would outweigh the pleasure of engaging in the criminal activity. Becker (1968), Stigler (1970), Polinsky and Shavell (1979), and Ehrlich (1996) laid the foundation upon which the theory of deterrence rests. Still others, such as Burnovski and Safra (1994), Deutsch, Hakim, and Spiegel (1990), and _____ have expanded on the theory to account for individuals who commit multiple illegal activities.

Scholars working at the folds of behavioral economics and law and economics - such as Sunstein (1997) and Jolls, Sunstein, and Thaler (1998) - have begun asking fundamental questions about the interaction between individuals and legal institutions. This early work has paved the way for a developing area of economics: behavioral law and economics. Garoupa (2007) provides an essay on the usefulness of behavioral economics in determining the optimal level of law enforcement, while Garoupa (2003) provides an excellent overview of the usefulness of behavioral economics.

DeAngelo and Charness (2009) examine the effect of uncertainty on an individual's decision to engage in a proscribed activity. A main finding of this work is that uncertainty over the enforcement mechanism yields additional deterrence without utilizing additional enforcement resources. Harel and Segal (1999) discuss this issue by asking whether increasing certainty in sentencing and uncertainty with respect to the probability of detection can be justified because criminals do not prefer such a regime. The findings in DeAngelo and Charness (2009) and Harel and Segal (1999) are qualitatively similar. From a different behavioral perspective, Baker, Harel, and Kugler (2004) use an experimental setting to test for the effect of uncertainty in deterrence mechanisms. Their findings report increases in the level of deterrence as a result of uncertainty over a deterrence mechanism. However, the experimental framework examines the effect of uncertainty in a risky environment, not an illegal environment.

Paragraph on Behavioral economics and recidivism- discussion about any papers that have discussed recidivism.

Paragraph combining the uncertainty and recidivism discussions in the behavioral literature.

Empirically, examining enforcement mechanisms and the level of recidivism can be difficult for at least three reasons. First, isolating changes in enforcement mechanisms is challenging in field data. Simultaneous changes in multiple enforcement tools make it quite challenging to ferret out the impact of a particular mechanism on undesirable actions. Second, an individual's knowledge of an enforcement mechanisms is uncertain. When the probability of being appre-

hended (hereafter probability) for a particular crime increases/decreases - even if no other enforcement mechanism changed - individuals can rarely discern the change in the probability. Third, field data can only account for recidivism through survey analysis[1], by estimating the level of recidivism[2], or calibrating recidivism rates[3].

The need to empirically examine recidivism has generated a modest number of studies. PAPERS HERE THAT HAVE DISCUSSED RECIDIVISM.

Paragraph: Discussion about why past work hsa not suitably examined recidivism and the effect that uncertainty has on recidivism

In this light, we conduct laboratory experiments that examine whether a risky environment relative to an uncertain environment generates greater recidivism. The effect of the expected cost of committing a proscribed activity on the level of recidivism is also tested. In short, our findings indicate that _____.

The remainder of this paper is organized as follows. Section 2 presents the details of our experimental design and discusses how this design can be seen as reflecting uncertainty. The experimental results are presented in section 3, and we discuss our results and conclude in section 4.

[1] See _____, _____, _____ for survey analyses on recidivism.
[2] See _____, _____, and_____.
[3] See _____, _____, and_____.

2 Experimental Design

We conducted nine experimental sessions at the University of California at Santa Barbara. Participants were recruited using ORSEE (Greiner 2004) from a campus-wide database of students who had registered for participation in paid experiments. A total of 125 students participated in the experiment, with no person permitted to participate in more than one session. The number of people in each session ranged from seven to 19, but was always an odd number. Average earnings for an experiment lasting less than one hour were about $15, including a $5 payment for showing up on time. Each session had an odd number of people present (to avoid ties in the voting stage described below).

One consideration was how to choose a proscribed activity. While we could ask the participants about serious crimes such as murder, extortion, etc., we thought it would be unlikely that they would indicate they would choose such activities, even in the lab. Thus, we wished to find a proscribed activity in which people frequently engage, as this seemed more likely to avoid strong emotional connotations. Speeding seems a natural choice that has also been discussed empirically discussed (see Ashenfelter and Greenstone (2003) and DeAngelo and Hansen (2009)).

We had two experimental settings. In both, we had 30 periods, which consisted of three blocks of 10 periods. In each period, a participant faced a choice of whether or not to speed. If the participant chose not to speed, the payoff for that period was $0.60. If the participant instead chose to speed, the payoff for the period was $1.00 less a possible fine if caught. Sample experimental

instructions are given in Appendix A.

We initially describe the first experimental setting, in which 87 people participated. In periods 1-10, people were first told that there was a 50% chance of being in each of two regimes. In regime 1, the probability of being caught was 1/3 and the fine if caught was \$0.90; in regime 2, the probability of being caught was 2/3 and the fine if caught was \$0.45. After being so informed, participants then decided whether or not to speed. The expected fine from speeding was \$0.30 in each case; since the net expected earnings from speeding (\$0.70) is greater than the earnings from not speeding (\$0.60), a risk-neutral person should prefer to speed in either regime. In periods 11-20, people first voted for either regime 1 or regime 2. The regime receiving the most votes (note that the odd number of participants in a session ensured that there were no ties) was implemented and the participants were informed of the applicable regime; the decision of whether or not to speed then followed. In periods 21-30, we introduced two new regimes. In the first of these, the probability of being caught speeding was 3/5 and the fine if caught was \$0.833; in the second, the probability of being caught speeding was 4/5 and the fine if caught was \$0.625. Thus, the expected fine if one chose to speed was \$0.50 in each of these regimes; since the net expected earnings from speeding (\$0.50) is less than the earnings from not speeding, a risk-neutral person should prefer to not speed in either regime.

Our second experimental setting, in which 38 people participated, was intended to control for the possibility that the act of voting changed one's pref-

erences. As before, in periods 1-10, people were first told that there was a 50% chance of being in each of two regimes. In regime 1, the probability of being caught was 1/3 and the fine if caught was \$0.90; in regime 2, the probability of being caught was 2/3 and the fine if caught was \$0.45. In periods 11-20, instead of having voting, we simply imposed one of the two regimes, and the regime was varied from one period to the next. People were told with certainty which regime would apply in the coming period;. Finally, periods 21-30 were the same environment as periods 11-20 in our first setting: people first voted for either regime 1 or regime 2. The regime receiving the most votes was implemented and the participants were informed of the applicable regime.

2.1 Uncertainty in our environment

The distinction between risk and uncertainty has been well addressed in the economics literature. Knight (1921) was one of the first written accounts that discussed this distinction, stating: "Uncertainty must be taken in a sense radically distinct from the familiar notion of Risk, from which it has never been properly separated.... It will appear that a measurable uncertainty, or 'risk' proper, as we shall use the term, is so far different from an unmeasurable one that it is not in effect an uncertainty at all." The so-called Ellsberg Paradox, as discussed in Ellsberg (1961), empirically examined an inconsistency in behavior amongst individuals that led the research to conclude that people's preferences distinguish between risk (known probabilities) and uncertainty (unknown probabilities). Keynes (1921) notes that taking a risk requires confidence. However,

Heath and Tversky (1991) point out that ambiguity also makes people shy away from taking either side of a bet, as not knowing important information about the environment is psychologically uncomfortable and effectively reduces confidence. Camerer and Weber (1992) present a survey of the extensive empirical work pertaining to the discussion of uncertainty and ambiguity.

There appears to be heterogeneity amongst researcher's beliefs about what constitutes uncertainty. One approach is normative and views ambiguity as a situation in which the decision-maker cannot assign probabilities to events. According to this approach, being ambiguity averse is perfectly rational and is a natural response to lack of information. In much of the research designed to examine the Ellsberg Paradox, it is assumed that individuals can reduce compound objective lotteries. An alternative approach is more descriptive and is based on the observation that there exists a very strong empirical association between ambiguity aversion and violation of reduction of compound lotteries. For example, Halevy (2007) discusses uncertainty – from the perspective of the decision maker – that arises from an individual's inability to comprehend compound lotteries or to calculate probabilities of final outcomes in compound lotteries according to the laws of probability. Since this is difficult or impossible to justify normatively, and can be safely viewed as a mistake or bias, the holders of this view tend to agree that ambiguity aversion is a form of bounded rationality. From this perspective, the use of compound lotteries in decision-making can in effect induce uncertainty. This is the perspective that we take in this paper, and we do in fact find consistent evidence that speeding rates are lower

when a compound lottery is present.

In our experiment, we have included uncertainty in the second, more descriptive manner. When voting does not exist in experimental rounds, there is a compound lottery involving the probability that a particular deterrence regime will be chosen. In accordance with Halevy (2007), if people are unable to reduce compound lotteries, then our experimental results in these rounds reflect the manner in which subjects respond to ambiguity or uncertainty. In our environment with voting for a preferred regime (with equivalent expected costs of committing a crime), the voters are informed of the regime that is implemented so that there is no compound lottery and, thus, only a risky environment remains. The presence of both risky and uncertain environments allows us to examine the effect of uncertainty on rates of recidivism.

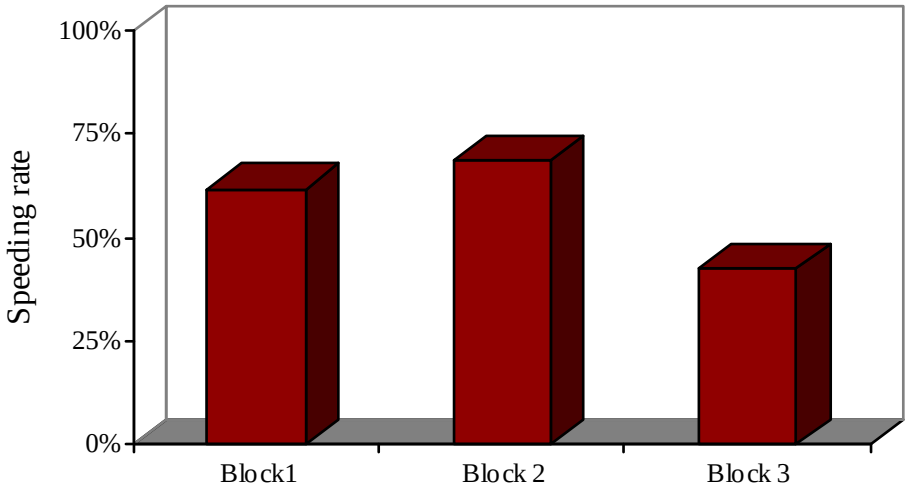
3 Experimental Results

We find strong evidence that people recidivate more frequently under _____ and _____ conditions. In this section, we first discuss each setting in turn, providing summary statistics and nonparametric statistical tests based on each individual's tendencies.

3.1 4.1 Results for Setting 1

Rates of speeding varied significantly by block. Figure 1 displays the rate of speeding by block (each block depicts 10 periods of the entire session; block 1

Figure 1 - Speeding rates by block of periods, Setting 1



represents periods 1-10, block 2 represents periods 11-20, and block 3 represents periods 21-30).

Note that the rate of speeding was marginally smaller in block 1 - the uncertain environment - relative to block 2 - the risky environment - and speeding rates are considerably lower in block 3 - the risky environment with higher expected costs of speeding. This difference in speeding rates is statistically significant according to the nonparametric binomial test (see Siegel and Castellan (1988)), using each individual's overall speeding rates in blocks 1 and 2. The speeding rate was higher in block 2 than in block 1 for 40 people, the same for 33 people, and lower for 14 people, yielding $Z = 3.54$ and $p = 0.000$.[4] The

[4] We can use this test because we have within-subject data on the various blocks and regimes. The logic of this test is that if people are behaving randomly, we should expect as many people to speed more frequently in regime 1 as there are people who speed more

larger difference in speeding rates between blocks 2 and 3 is also statistically significant according to the nonparametric binomial test; the speeding rate was higher in block 2 than in block 3 for 61 people, the same for 23 people, and lower for only three people, yielding $Z = 7.25$ and $p = 0.000$.

Table 1 examines speeding rates by blocks.

Table 1 – Speeding rates by block of periods, Setting 1

Block	Overall Rate	Obs, regime 1	Rate, regime 1	Obs, regime 2	Rate, regime 2
1	0.616 (0.016)	461	0.616 (0.023)	409	0.617 (0.024)
2	0.685 (0.016)	513	0.671 (0.021)	357	0.706 (0.024)
3	0.424 (0.016)	686	0.461 (0.019)	184	0.288 (0.033)

Standard errors are in parentheses

Speeding rates were nearly identical for each regime in block 1, since individuals did not know which regime was in place, ex ante. In block 2 - when people are able to vote for regime 1 (with a 1/3 chance of detection and a 0.90 fine if detected speeding) or regime 2 (with a 2/3 chance of detection and a 0.45 fine if detected speeding) - 59.0% of the votes were for regime 1. However, there is no statistical difference in the speeding rate depending on the regime that is in place; the binomial test gives $Z = 1.04$ and $p = 0.298$. The preference for regime 1 (a fine of 0.625 units with a probability of detection of 4/5) over regime 2 (a fine of 0.833 with a detection probability of 3/5) is stronger in block 3, with 78.9% of the votes in favor of regime 1. In this case, we do have a substantial and significant difference in speeding rates depending on the regime;

frequently in regime 2. If these numbers differ a great deal, this indicates that behavior is not random.

the binomial test gives $Z = 3.88$ and $p = 0.000$.

Table 2 displays the rates of recidivism and average time interval until an individual recidivates.

Table 2 - Recidivism Count and Length, Setting 1

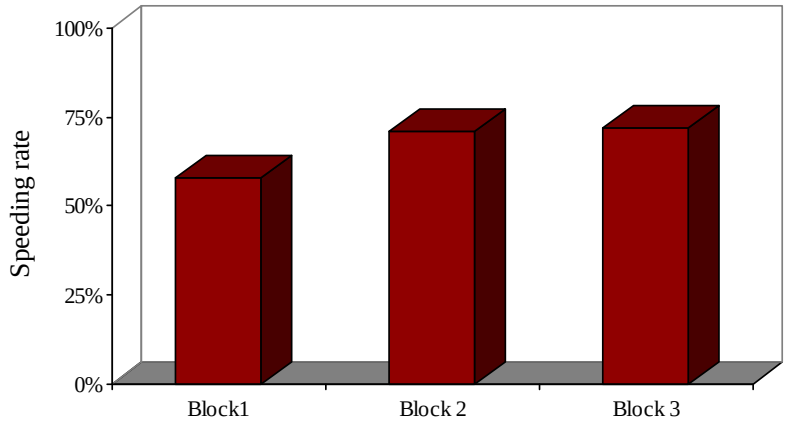
Block	Recidivism Count	Recidivism Length
Block 1	4.213 (1.687)	1.298 (0.624)
Block 2	5.502 (2.1616)	1.230 (0.487)
Block 3	4.420 (1.781)	1.562 (1.048)

Standard errors are in parentheses

The number of times that an individual decided to speed after being caught was higher in block 2 relative to both block 1 and block 3. In block 2 - the risky environment - individuals will, on average, speed one additional time after being caught relative to block 1 - the uncertain environment - and block 3 - the higher expected cost environment. The higher level of recidivism in block 2 relative to block 1 and black 3 is statistically significant as well; the binomial test gives $Z = 20.655$ and $p = 0.000$ for block 2 relative to block 1 and $Z = 14.413$ and $p = 0.000$.

The length until an individual attempts to commit a proscribed activity is similar in the risky versus uncertain environment and longer when the expected cost of speeding is larger. However, the length of time until an individual revidivates is significantly longer in block 1 relative to block 2; the binomial test reports $Z = 12.028$. Moreover, the length of time until an individual recidivates is significantly longer in block 3 relative to block 2 as well; the

Figure 2 - Speeding rates by block of periods, Setting 2



binomial test reports $Z = 12.030$. Thus, we see the risky and higher expected cost environments yield less recidivism and longer periods of deterrence relative to the uncertain environment.

3.2 4.2 Results for Setting 2

As observed in setting 1, setting 2 finds significantly less speeding in block 1 as opposed to blocks 2 and 3. Recall that the main differences between setting 1 and setting 2 are in the second and third blocks. Block 2 of setting 2 implements an enforcement regime without voting (as was the case in block 2 of setting 1). In addition, block 3 of setting 1 implemented a higher expected cost of speeding while block 3 of setting 2 is a carbon copy of block 2 of setting 1. Figure 3 provides a visual illustration of the overall speeding rates in setting 2, according to each 10-period block.

Table 3 - Speeding Rates by Block of Periods, Setting 2

Block	Overall Rate	Obs, regime 1	Rate, regime 1	Obs, regime 2	Rate, regime 2
1	0.579 (0.025)	217	0.567 (0.034)	163	0.595 (0.039)
2	0.711 (0.023)	191	0.639 (0.035)	189	0.783 (0.030)
3	0.721 (0.023)	342	0.719 (0.024)	38	0.737 (0.073)

Standard errors are in parentheses

Table 4 - Recidivism Count and Length, Setting 2

Block	Recidivism Count	Recidivism Length
Block 1	4.194 (1.479)	1.319 (0.487)
Block 2	4.279 (1.976)	1.198 (0.557)
Block 3	4.188 (1.468)	1.625 (0.932)

Standard errors are in parentheses

4 Conclusion

Conclude here

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Appendix A

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