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ABSTRACT

Traditional criminological research in the area of rational choice and crime decisions places a strong emphasis on offenders' perceptions of risk associated with various crimes. Yet, this literature has thus far generally neglected the role of individual overconfidence in both the formation of subjective risk perceptions and the association between risk and crime. In other types of high risk behaviors which serve as analogs to crime, including stock trading and uncertain business and investment decisions, overconfidence is shown to have a stimulating effect on an individuals' willingness to engage in these behaviors. Using data from two separate samples, this paper explores the prevalence of overconfidence in offending risk perceptions for a variety of crime types, and, in one sample serious offending juveniles, attempts to link overconfidence to a higher likelihood of offending. Our results show that overconfidence is both highly prevalent in risk perceptions across samples, and it is highly associated with higher rates of offending, even when controlling for risk. We also outline several theoretical issues for future research on this topic, including its relationship to self-serving bias and Bayesian updating.

Keywords: overconfidence, deterrence, risk perceptions, offending

"A Good Man Always Knows His Limitations": Overconfidence in Criminal Offending

"Dirty Harry" Callahan: Well, I just work for the city, Briggs!
Lieutenant Briggs: So do I, longer than you, and I never had to take my gun out of its holster once. I'm proud of that.
Callahan: Well, you're a good man, lieutenant. A good man always knows his limitations... [1]
Magnum Force

INTRODUCTION

According to rational choice theory in criminology, in order for a person to commit a crime the perceived outcomes of committing a criminal offense, weighted by the probability of those outcomes, must be greater than the perceived outcomes of non-criminal offending, weighted by the subjective probability of those legal outcomes (Cornish and Clarke 1986). Lower perceived probabilities of getting caught for committing a criminal offense would, therefore, increase the risk that the person would choose the illegal (stealing, drug dealing, assault) over the legal (having a job, negotiating out of difficulties) action. The perception of the risk or certainty of apprehension and punishment is affected by, among other things, the level of objective risk, the individual's experiences with crime and non-crime, second-hand information from criminal and non-criminal others, and exposure to the media (Lochner 2007; Matsueda, Kreager and Huizinga 2006; Paternoster 2010). Previous research in criminology and other fields has also suggested that the effect of sanction threats on criminal wrong-doing is likely affected by individual differences across would-be offenders such as gender (Powell and Ansic 1997; Carmichael et al. 2005), the person's level of self-control (Pogarsky 2002; Wright et al. 2004), moral beliefs (Bachman, Paternoster and Ward 1992), or the extent to which they were strongly or weakly bonded (Nagin and Paternoster 1991).

The perception of risk and its relation to offending may also, however, be systematically biased or distorted by the person's *feelings of overconfidence*. Those who are overconfident

would tend to think that their probability of being detected for committing a crime is lower, sometimes much lower, than what is warranted given their ability, and such overconfidence in their ability to escape the costs of crime would put them at higher risk of offending. Overconfidence in one's ability has been shown to be a pervasive human characteristic that affects decision making in diverse life domains including business and finance, athletics, medicine, and meteorology. In many instances, decision makers' feelings of overconfidence lead them to make unwise decisions in the sense that the decisions produce undesired rather than desired outcomes. For example, Roll (1986) and Ben-David, Graham and Harvey (2010) found that overconfident business executives were more likely to pay more than what firms were worth in corporate takeovers (see also Thaler 1988 for the "winner's curse"), overconfidence leads those with insufficient business experience to create start-up companies, most of which fail (Camerer and Lovallo 1999; Koellinger, Minniti, and Schade 2007), overconfidence, among other things, distorts NFL teams' ability to predict the future value of the players they draft leading them to overvalue their eventual performance (Massey and Thaler 2010), and overconfidence has been shown to be related to excessive trading of stocks and a below average rate of return (Barber and Odean 2001). The hypothesis that we directly test in this paper is that overconfidence about one's abilities and knowledge is related to greater criminal offending. Much as an overconfident stock trader trades more frequently than one with less confidence (Barber and Odean 2001), an overconfident criminal may commit more crimes.

THE CONNECTION BETWEEN OVERCONFIDENCE AND CRIME: SELF-ATTRIBUTION BIAS AND BAYESIAN UPDATING

OVERCONFIDENCE, UNWISE DECISIONS AND CRIME

While criminologists have investigated the role of other stable individual differences in the deterrence process, they have not explicitly concerned themselves with overconfidence.[2] There are different dimensions or variations of overconfidence (Moore and Healy 2008; Gieco and Hogarth 2009). For example, one type of overconfidence, overestimation, occurs when we overestimate our ability to do something, like pick out a successful common stock or commit a crime. A second type, the "better-than-average" effect, is the type of overconfidence we feel when we think that we have more ability relative to others, that I can drive a car better than you can or run a faster mile. A third type of over confidence, overprecision, occurs when I am overconfident about my ability to estimate some uncertain future event, for example, providing an estimate of what my worth will be when I retire. While acknowledging these differences, we are less concerned here with differentiating them. The overconfidence we are concerned with is more like the "better than average" effect because would-be offenders compare their own subjective probability of getting caught for a crime against other persons. We also acknowledge the importance of overestimation, however, because these would-be offenders take the signal provided by this comparison as providing information about their superior ability to commit crime and escape detection. As we will describe in more detail below, this information is subject to bias and distorts the individual's updating of their own subjective probability of risk, leading them to think that they have more ability than they really possess.

Although a relatively new concept for criminologists, economists and psychologists have devoted considerable research and theoretical attention to it and have mapped out some of the characteristics and consequences of being overconfident. Their work would clearly suggest that being overconfident about one's abilities and knowledge should be at least modestly related to criminal offending as their empirical studies have found that:

- Being overconfident leads to higher than average trades of common stock among investors but lower than average rates of return (Odean 1998, 1999; Barber and Odean 2001). It also leads to other bad investment decisions including the decision by executives to commit corporate fraud in the short term under the mistaken assumption that they have the ability to make their business more profitable in the long term (Schrand and Zechman 2008). In a number of different domains, overconfidence frequently leads to the making of unwise decisions and undesirable and unwanted outcomes rather than desired outcomes.
- As the case with criminal offending, males are significantly more overconfident than females, particularly single men, and younger people are more overconfident than those who are older (Lenny 1977; Lundeberg, Fox, and Punćochaŕ 1994; Pan and Statman 2010).
- Overconfidence is most likely to develop for outcomes with low rather than high probabilities (Lichtenstein, Fischhoff and Phillips 1982).
- Overconfidence is most likely for outcomes lacking fast and clear feedback (Fischhoff, Slovic and Lichtenstein 1977).

The requisite context for the development of feelings of overconfidence, low probability events where the feedback is not generally fast nor clear, would seem to provide a good description of criminal behaviors. The probability of detection is objectively very low for most offenses, punishment rarely comes fast, and very little about the feedback can be said to be clear. We would expect, therefore, that the decision to commit criminal offenses would breed overconfidence which in turn would drive additional crime. The fact that overconfidence may in the long-run result in behaviors that are at odds with one's self-interest is also characteristic of

crime, as is the fact that overconfidence, like crime, appears to be more characteristic of men than women and the younger more than the older.

While there is a literature with respect to the role of overconfidence in bad, risky or imprudent business decisions (Heaton 2002; Ben-David, Graham, and Harvey 2007; Puri and Robinson 2005; Malmendier and Tate 2005, 2008), to our knowledge there has been only one direct empirical study of the relationship between overconfidence and crime, and not surprisingly it is in the area of corporate finance decisions. Schrand and Zechman (2008) argued that in any one period a failure to meet expected earnings by a company is easily ignored or go undetected. If earnings do not improve in the subsequent period, however, a manager must apply increasing effort to hide the fact that earnings are not performing at expectations, or reveal the poor performance. They further argue that an overconfident financial manager is more likely than one less confident to have unrealistic beliefs about an eventual improvement in future earnings performance that are bleak in the present. These overconfident managers will find themselves falling further behind earnings expectations to the point that earnings shortfalls become increasingly more difficult to hide and the manager is forced to "start down the slippery slope to fraud" as the only way to continue the earnings ruse (Schrand and Zechman 2008:2). These authors found at the firm-level that industries that attract overconfident executives have a greater proportion of frauds, and at the individual level overconfident managers are more likely to commit fraud in the face of lower than expected earnings and those with extreme overconfidence were more likely to commit opportunistic fraud – committing fraud when it was self-serving.[3]

While it might be clear that feelings of overconfidence are likely related to bad investment and other financial decisions, it might not yet be entirely convincing why we would expect feelings of overconfidence to be related to criminal offending. In the following section, drawing heavily from an explanation of investor overconfidence found in Gervais and Odean (2001), we

link overconfidence in criminal decision making to perceived criminal abilities and to a type of self-serving bias that occurs in a process of Bayesian updating of perceived sanction threats to explain why we hypothesize that those who are overconfident with respect to their criminal abilities will commit more crimes.

SELF-ATTRIBUTION BIAS AND BAYESIAN UPDATING

Our argument is that would-be criminals are initially unsure of their ability to successfully commit crimes. They are not initially overconfident, in fact they may underestimate their ability and overstate the risks of offending (Jensen 1969; Tittle 1980) - in other words, they may be "chicken" and in Bayes' rule they may overestimate their prior for the risk of apprehension. Many if not most persons do overcome what Matza (1964) referred to as the "apprehensiveness component" and begin to commit offenses, maybe initially only acts that "stretch" the law (smoking cigarettes, skipping school, drinking alcohol) then maybe only minor crimes (stealing from stores, vandalizing). But offenses are committed, and offenders learn about their ability by committing crimes, observing the consequences of those crimes, and then adjusting their prior perceptions of their abilities. In a by now well documented process of Bayesian updating (Anwar and Loughran 2011; Horney and Marshall 1992; Lochner 2007; Matsueda, Kreager and Huizinga 2006; Parker and Grasmick 1979; Pogarsky, Piquero and Paternoster 2004; Nagin 1998) offenders receive signals about their ability to commit crime by either getting away with it or getting caught and modify their prior perception of their ability on the basis of this signal. In Bayes' rule, the rational subject updates his prior beliefs based on new information with the new beliefs consisting of a weighted function of the prior belief and the new information.

If the updating is unbiased then the weight assigned to a successful crime would be comparable to the weight assigned to an unsuccessful crime and the rational person would also

consider how much information the signal should provide. So, for example, a person who commits one criminal act during time period *t* and gets away with it might not assign this signal that much weight since it was only one consequence, waiting for additional information provided by a subsequent time period before gradually updating their prior. But suppose that persons are not unbiased with respect to the signals provided by their behaviors? How would this bias affect their use of Bayes' rule? One consistent finding in cognitive psychology is that people tend to take too much credit for their successes and too little responsibility for their failures. This self-enhancing attribution bias leads us to persistently believe that our successes (like getting away with a crime) are due to our own ability and effort while our failures (like getting caught for crime) are attributed to external sources or chance (Fiske and Taylor 2007; Miller and Ross 1975). In the presence of this attribution bias, whose magnitude would very likely vary across persons, several things can occur that are relevant to the connection between the kind of Bayesian updating that goes on in response to signals or information about one's ability to commit crimes and criminal decision making.

First, when initially committing a criminal act with success during period *t* a person with a high self-enhancing attribution bias could easily: (1) believe that this success was due to his own skills and ability rather than chance, (2) as a result, he would suddenly update his perception of his own ability, overweight their success and jump to the conclusion that he is a high-ability offender rather than waiting for additional information from another, subsequent time period and then gradually updating his beliefs. The latter point is a reminder that a less perceptually biased person might wait for additional information before updating the perception of his ability upward if his success continues, or downward if actions are met with failure. One with a strong self-enhancing attribution bias, however, will become overly confident with initial success, believing that success is a true signal of his abilities, and will subsequently overweight his successes and

underweight his failures when applying Bayes' rule to the updating of his beliefs. A biased perception of the information that is provided by one's successes and failures, therefore, leads to overconfidence with respect to one's criminal abilities with the result that more crime is committed.

As Gervais and Odean (2001) explain with respect to stock traders, the implication of this is that offenders would be expected to be more overconfident early in their careers. Not starting out overconfident, but perhaps even underconfident, initial success for one with high self-enhancing attribution bias will lead to a dramatic updating of one's abilities and, in turn, more crime. In the short-run, therefore, the rate of success that one has may be greater than one's actual criminal ability. If that real ability is less than the perceived ability, the person is likely going to meet with more failures and unless the attribution bias is particularly acute it will eventually force a convergence between the offender's perceived and real ability. In other words, though initially successful and overconfident in the short-term, over the long-term an offender's rate of success will eventual conform to their real abilities and most offenders will eventually "learn" that they are not so skilled. The implication of this, of course, is that in the long-run many if not most offenders will eventually realize they are of limited criminal ability, or at least of less ability than they once thought, and begin to desist from crime. This expectation is quite consistent with the ethnographic literature on "delayed deterrence" or the eventual "aging out" of crime (Shover 1983, 1996).

There are a number of implications of the explanation of how individual traits such as overconfidence and the self-serving attribution bias are related to crime by way of the process of Bayesian updating. For example, we would predict that two individual traits should be positively related – the tendency to be overconfident and having a self-serving attribution bias. We have also alluded to the fact that self-confidence among all but the most biased of offenders should

decline over time – offenders should be overly confident early in their careers but such overconfidence is likely to be corrected in the long-run as perceived and real abilities begin to converge. Another implication is that the greater the self-attribution bias the longer it will take for overconfidence to be corrected, and that when this bias is particularly severe it may never get corrected (there may be persistent offenders). We think that our linking of the self-attribution bias, overconfidence, Bayesian updating, and criminal decision making not only holds promise of explaining a great many empirical regularities in criminology, but offers a rich, potentially productive, and exciting research agenda. In this paper, however, we are able to explore only one of the implications of our conjecture – but it is the most basic implication of our explanation. If what we think is true, then a simple but fundamental implication is that persons who are overconfident with respect to their criminal abilities should commit more offenses than the less confident. It is examining this basic implication that we set our sights on in this paper.

CURRENT FOCUS

This paper investigates several questions related to overconfidence in offending perceptions and the consequences of such overconfidence for criminal offending. First, we explore the prevalence of overconfidence in offending risk across two unique samples— a sample of serious and active juvenile offenders and a sample of high school students. In both samples, respondents were asked about their own perceived certainty of apprehension and that for a generalized other – for serious offenses (e.g., stealing, assault) in the juvenile offender sample and more common offenses (e.g., shoplifting, underage drinking) in the conventional high school sample. Second, within the serious offending sample, we are also interested in the association between overconfidence and offending. Specifically, we explore descriptively if overconfidence is associated with a higher probability of self-reported offending (SRO), both overall, and by

certain specific crime types. Third and most importantly, given that we know overconfidence is a function of the risk for generalized others, and thus positively correlated, we would also like to know if there is an independent association between offending and overconfidence, once we control for an individual's perception of others' risk. This would address the question; "conditional on a baseline assessment of risk (the risk to a generalized other which has been repeatedly shown to associate negatively with offending; Nagin 1998), is there an additional relationship between overconfidence for one's self and offending?" Finally, we consider some implications of these results for deterrence and criminal decision-making, and lay out some important directions for future research.

MODEL

Measuring Overconfidence

To measure overconfidence, we consider two separate sets of subjective, individual perceptions regarding risks associated with criminal offending. First, we consider an individual's *self* risk, that is, the individual's subjective belief concerning how likely it is *he or she* will be apprehended for committing a given criminal act. Second, we also consider an individual's *other* risk, or individual's subjective belief concerning how likely it is that a generalized other person will be apprehended for committing the criminal act. Importantly, note that what we refer to as self risk is the traditional measure of subjective risk used widely in individual-level studies of perceptual deterrence (e.g., Paternoster 1987; Matsueda et al. 2006; Nagin 1998). Much rarer in recent research is the use of generalized other risk in offender perception studies, and we are aware of no studies which use the combination of these two measures to study associations between their discrepancy and offending.

Our measure of overconfidence (OC) is simply the difference between an individual's other risk and self risk:

$$OC_i = other_i - self_i \qquad [1]$$

This measure is attractive in that it is quite simple and intuitive. For example, suppose a certain individual perceives that if s/he steals a car, there is a 30% chance they would get caught (i.e., self), and this same individual thinks if another random individual steals a car, there is a 30% chance that this person would be apprehended (i.e., other). Clearly, the individual in question feels that they have the same likelihood of arrest as would the 'average' offender. In this case, the original individual reveals no overconfidence, and $OC_i = 0$. Now suppose instead that the same individual who believed that there was a 30% chance they would be apprehended for stealing a car, believed that another individual would probably be caught 50% of the time for stealing a car. Now the individual perceives that they are actually *less likely* than the average offender to get caught for stealing a car, and this is reflected in the measure $OC_i = 20$. Further, the larger the value of OC_i is, the greater the discrepancy one's self and other perceptions, and as a result, the more overconfident this individual would be.[4] Similarly, a negative score on this measure is also meaningful. Consider another individual who believes there is a 30% chance they would be apprehended for stealing a car, but thinks that there is only a 10% chance that another random individual would get caught for stealing a car. Here, $OC_i = -20$ displays underconfidence.[5]

The Association of Overconfidence and Offending

As described above, we are interested in the association between overconfidence and criminal offending. In general, a test of the bivariate association between these two factors would be sufficient, yet such a simplistic model fails to capture the importance of self and other risk perceptions when deriving overconfidence in the first place. Specifically, the magnitude of an individual's overconfidence is dependent on their perception of others' risk, that is, to be overconfident, an individual's risk perception for generalized others must exceed their self risk.

Further, there is a well-documented negative association between perceived risk for self and offending (Nagin, 1998) which must be accounted for since overconfidence is derived from risk, and as such these two are likely correlated. Therefore, it is important to test for an additional association between overconfidence and offending, controlling for the risk for generalized others. Such a model would be:

$$SRO_i = \beta_0 + \beta_1\, other_i + \beta_2\, (other_i - self_i) + \varepsilon_i \qquad [2]$$

Again, *other – self* is a measure of overconfidence. In this model, we would expect $\beta_1 < 0$ (i.e., a negative risk-offending association) and $\beta_2 > 0$ (i.e., an overconfidence effect). Since overconfidence is itself a function of other risk, we can rearrange the terms in this model. In the reduced form, equation [2] can be rewritten as:

$$SRO_i = \pi_0 + \pi_1\, other_i + \pi_2\, self_i + u_i \qquad [3]$$

This simply means that in order to test for the incremental of association of overconfidence conditional on risk we can simply regress SRO on self and other risk. In this reduced form model, we would expect to find $\pi_2 = -\beta_2 < 0$, which would demonstrate an overconfidence effect, and since $\pi_1 = (\beta_1 + \beta_2)$, then $\beta_1 = \pi_1 - \beta_2$, or $\beta_1 = \pi_1 + \pi_2 < 0$ would be evidence of a negative risk-offending association.

DATA

We investigate overconfidence in offending risk perceptions in two unique samples—one sample of primarily non-offending high school students, who reveal perceptions about minor offenses, as well as second sample of active and serious offending juveniles, from whom we learn about perceptions regarding more serious offense types. The benefits of using multiple samples are threefold. First, this strategy allows us to explore overconfidence in multiple types of offending perceptions, ranging from relative minor to very serious offense types. Second, we are able to compare the prevalence of overconfidence between offenders and a group of mainly non-

offenders. Third, the use of two samples affords us the chance for internal replication with independent samples (Firebaugh 2008). We now briefly describe each sample. Descriptive information for both samples is provided in Table 1.

* Table 1 about here *

HIGH SCHOOL SAMPLE

Data are from a cohort of high school-aged youth in Columbia, South Carolina, which were used in previous studies of perceptual deterrence (Paternoster 1988; Paternoster et al. 1983; Paternoster and Piquero 1998). Surveys were conducted in three consecutive years in nine local high schools. Students were interviewed for the first time at the beginning of their sophomore year in high school. An identical questionnaire was given to the same students when they were in the 11th and 12th grades. The present study uses questions measuring respondents' perceived certainty of punishment toward four crimes: shoplifting, property damage (i.e., vandalism), underage drinking and underage smoking.

Risk Perception Measures

In this South Carolina (SC) sample, individuals are asked how likely it is (on a range from 0-100) they think *they* would be caught for committing each of the four offenses at each period, which represents an individual's self risk perception. The respondents were also asked, of the *next 100 individuals* who commit each of the four offenses, how many they think will be caught (on a range from 0-100). This long run frequency of other persons getting caught for each crime is treated as the individual's generalized other risk perception. Summary statistics for each risk measure are provided in Table 2.[6]

* Table 2 about here *

OFFENDING SAMPLE

These data are taken from the Pathways to Desistance study, a longitudinal investigation of serious adolescent offenders transitioning from adolescence to young adulthood. Participants are young males who were found guilty of a serious offense (almost entirely felony offenses) in the juvenile or adult court systems of Maricopa County, AZ or Philadelphia County, PA. These youth were ages 14 to 17 at the time of the study. A total of 1,354 adolescents are enrolled in the study, representing approximately one in three adolescents adjudicated on the enumerated charges in each locale during the recruitment period (November, 2000 through January, 2003). The study sample is predominantly comprised of minority (41.3% African American, 33.5% Hispanic) males (86.4%).

The data analyzed here were collected at six consecutive observational periods of six-month follow-up interviews over the first 36 months of the study. Follow-up rates at each subsequent observation period exceed 90%, suggesting very low sample attrition. Information regarding the rationale and overall design of the study can be found in Mulvey et al. (2004), while details regarding recruitment, a description of the full sample, and the study methodology are discussed in Schubert et al. (2004). These data have been used to study a variety of criminological questions, but only a handful of investigations have examined deterrence-related issues and none of these have considered the overconfidence question (see Fagan and Piquero 2007; Loughran et al. 2011a,b; Anwar and Loughran 2011).

Risk Perception Measures

There are seven unique crimes for which risk perceptions are elicited: breaking-in, stealing, theft, and robbery (which we classify as income-generating crimes), as well as vandalism, fighting, and stabbing (which we classify as aggressive crimes). Individuals were asked at each observation period how likely it is that *they* would be caught and arrested for each of the seven crimes. Responses ranged from 0 (no chance) to 10 (absolutely certain to be caught).

The mean (either overall, or for each offense category) was then calculated from these responses. This constituted the individual's self risk. Similarly, each individual was also asked how likely they thought it is that *someone else* would be caught and arrested for each of the seven crimes, again on the 0-10 scale. The mean responses for this question represent an individual's risk perception for a generalized other.

Self-Reported Offending Measures

This measure is a revised version of a common self-reported delinquency measure of the number of crimes committed (Huizinga et al. 1991). In the Pathways study, the self-report scale included 22 serious offenses. We trim this scale even further to 17 offenses to eliminate crimes which we deem not to have a direct relationship with the measures of risk perception, and these 17 offenses were divided into aggressive and income-generating categories. In each period, an individual is asked whether they committed each of these 17 crimes in the past 6 months. A binary measure of self-reported offending (SRO) was then created to identify individuals who committed at least one offense during the period any of the crimes in either crime class. The probabilities of offending by crime class over time, along with mean self and other risk perceptions for this sample are reported in Table 3.

* Table 3 about here *

Arrests

The measure of an individual's arrests in each period they are under 18 are based on reports of petitions to juvenile court recorded in the Juvenile Online Legal Tracking System (JOLTS) used in Maricopa County and the juvenile court database in Philadelphia County. Probation violations before the age of 18 were excluded since they do not necessarily represent a new offense, and may indicate local practices as much as adolescent behavior. Arrests after the age of 18 were based on merging the court record information from each jurisdiction with

nationwide FBI arrest records. We match the arrests to the specific period in which they occurred. Table X shows that about 16% of the individuals are arrested at least once during the first six month period in the sample.

RESULTS

PREVALENCE OF OVERCONFIDENCE AMONG OFFENDERS AND NON-OFFENDERS

Table 4 reports descriptive statistics for overconfidence in the South Carolina high school sample. First it is important to note that there is a tremendous amount of variability in the distribution of overconfidence, as evidenced by the large standard deviations of each measurement. Recalling the key measurement fact that overconfidence is measured as the difference between self and other risk, this standard deviation can be thought of as a description of the amount of variability in the difference between these two risk perceptions. For example, at the first time period, overconfidence, or the discrepancy between self and other risk, for shoplifting has a standard deviation of 31.57%, which is quite large in terms of describing the differences in these perceptions for the same individual. The smallest standard deviation in Table 3 is for drinking in the third time period, 22.42%, which still indicates a great deal of variability. In addition to the variation in overconfidence, we can also look at the percentage of individuals who are overconfident, i.e., those individuals who report lower self risk than other risk. Crimes that we think of as merely "stretching the law", specifically drinking and smoking, have the highest percentage of individuals who are overconfident, near or exceeding 50% of individuals in either case. Furthermore, these percentages of overconfident individuals show little, if any, decline over time, meaning that for these offenses, individuals tend not lose their overconfidence beliefs over time. For shoplifting and vandalism, crimes we might think of a more serious yet

still minor, the percentage of overconfidence is smaller, and it exhibits some decline over time. Yet generally, all of these percentages are relatively stable over time.

* Table 4 about here *

Table 5 reports similar descriptive statistics for overconfidence in the Pathways serious offending sample. Once again, the standard deviations reported in the table, while not necessarily as large as those found in the non-offending sample, are still large enough to demonstrate substantial amount of discrepancy between self and other risk, even among active offenders.[7] First, notice that there are only slight differences between income-generating crimes and aggressive crimes in terms of the variability and percentage of overconfident individuals. These differences are subtle at best, but likely unimportant. Second, note that as opposed to the offenses queried in the high school sample which could be thought of as more minor and more common (e.g., smoking, drinking), the more serious offenses considered here tend to have a lower percentage of overconfident individuals. Furthermore, in each case in Table 4, the percentage of overconfident individuals starts out high (near 45-46%) but over time diminishes somewhat. These patterns for overconfidence associated with more serious crimes are clearly different than the pattern for less serious crimes described in the non-offending sample, although the reason for this difference—be it due to offense-specific or offender-specific reasons—is difficult to untangle, and certainly outside the scope of this analysis. What is clear, however, is that whatever belief-updating process which is necessary to reveal such a changing pattern over time is consistent with some sort of experience-dependant learning process, either Bayesian or other.

* Table 5 about here *

ASSOCIATION BETWEEN OVERCONFIDENCE AND OFFENDING

Table 6, Column I, III and V report the results of the bivariate association between binary SRO and overconfidence for all offenses combined, income-generating offenses and aggressive

offenses respectively. In each of these models, overconfidence, equal to the difference between other and self risk, is entered as the sole regressor. In each case, notice that there is a positive and statistically significant effect of overconfidence, that is, more overconfidence is associated with a higher probability of offending, regardless of offense type.[8] The marginal effect of overconfidence for all offenses is .017, that is, every 10% increase in overconfidence is associated with a 1.7% increase in the probability of offending.[9] Similarly, the marginal effects of overconfidence for income-generating crimes and aggressive crimes are .010 and .017, respectively.

* Table 6 about here *

Column II reports results for the association of offending and overconfidence for all offenses after controlling for other risk. For all crimes combined, the logit coefficient for self risk is negative and highly statistically significant. Recall that when estimating equation [3], the coefficient on self risk is the opposite of the coefficient on overconfidence in equation [2]. Thus, we can conclude that when controlling for other risk, i.e., the 'average' risk perception that an individual perceives, overconfidence is uniquely associated with a higher probability of offending. And this association is stronger depending upon the degree of overconfidence—that marginal effect of overconfidence here is .022, or, holding other risk constant, a 10% increase in overconfidence is associated a 2.2% higher likelihood of offending. Also, notice that this specification also displays strong evidence of a negative risk-offending association, which is highly congruent with deterrence theory. Specifically, as described above, the sum coefficients on self and other risk should be less than zero to demonstrate such an association. The chi-squared test statistic of 91.91 allows us to comfortably reject the null hypothesis that these coefficients sum to zero, in favor of the alternative that they sum to less than zero.

Columns IV and VI report similar results for income-generating and aggressive crimes, respectively. For income-generating crimes, the marginal effect of overconfidence suggests that a 10% increase in overconfidence is associated with a 1.4% increase in the probability of offending, controlling for other risk. Further, there is strong evidence of a negative risk-offending relationship ($\chi^2 = 122.43$). For aggressive crimes, a 10% increase in overconfidence is associated with a 2.2% increase in the probability of offending, controlling for other risk. Again, there is very convincing evidence of negative risk-offending association ($\chi^2 = 96.53$).

Taken together, these results suggest that overconfidence is strongly linked with a higher likelihood of offending, even after controlling for other risk, and that this association holds regardless of crime type, although the magnitude of the association may be larger for aggressive crimes as opposed to income-generating crimes. Furthermore, the magnitude of this association is dependent on the degree of overconfidence, where the more overconfident an individual is, the higher the likelihood of offending.

LINKING OVERCONFIDENCE TO SUBSEQUENT OFFENDING AND ARREST

The previous descriptive results were intended mainly to demonstrate an as of yet undocumented association between overconfidence and contemporaneous criminal offending. However, what is not clear from these basic associations is the causal direction of this relationship, or more specifically, if overconfidence *leads* to a higher likelihood of subsequent offending, or is merely the result of it. We now attempt to begin to disentangle this relationship by exploring the linkages between overconfidence reported in period t and subsequent offending in period $t + 1$.[10] Further, we consider the additional outcome of arrest in period $t + 1$, which unlike offending can be thought of an *unfavorable* outcome from the perspective of the offender. Thus we examine if, as is well documented in studies of overconfidence from other disciplines,

overconfidence leads to unwise decisions with bad results on the part of the decision-maker. We note however, that a formal model of updating which fully integrates overconfidence is beyond the scope of the current study, yet it is clearly a direction for future research on this topic.

We begin by considering a 2X2 matrix of self and other risk, where each is delineated by splitting those individuals who fall above and below the median of each.[11] The matrix is shown in Figure 1. Individuals who fall into the first quadrant can be thought of as having low other risk but high self risk (which we denote as LOHS, for Low Other High Self). Overall, this group contains 11.42% of the pooled observations. Those falling in the second quadrant are both low other risk and low self risk (LOLS), which contains about 38.18% of the observations. The third quadrant represents individuals with high other risk but low self risk (HOLS), about 10.28% of the observations. Finally the fourth quadrant is populated by those with both high other risk and high self risk (HOHS). This is the largest group with 40.12% of the pooled observations. Individuals who fall into the HOLS classification can be thought of as being overconfident, i.e., their own perceptions are less than that of their other perceptions. Similarly, those classified as LOHS might be thought of as underconfident. In the context of this matrix scheme, the LOLS and HOHS groups are neither over nor under confident.[12]

* Figure 1 about here *

Again, it is important to point out that we think of an individual's other risk as their best guess at the base rate of detection, and self risk as an approximation of how close their own detection probability is to that base rate. Therefore, we condition on other risk in assessing the role of overconfidence. Specifically, an overconfidence effect is demonstrated if given individuals with high other risk, the probability of offending is larger for those with low self risk as compared to high self risk. Mathematically, this can be represented as $P(\text{offend} \mid \text{HOLS}) > P(\text{offend} \mid \text{HOHS})$. Similarly, a suppression effect of underconfidence would be demonstrated by

showing that, conditional on low other risk, those with high self risk are less likely to offend than those with low self risk. This can be written as $P(\text{offend} \mid \text{LOHS}) < P(\text{offend} \mid \text{LOLS})$.[13]

We test this possibility by including indicators for membership in each of these conditions, as reported in period t, in a logit model using offending in $t + 1$ as the outcome. We begin with a simple pooled cross-sectional logit model with standard errors cluster-corrected at the individual level. We then fit a two-level random effects logit model. This strategy is designed to account for the relative similarity of multiple observations made on same individual and better capitalize on the utility of the longitudinal data.

Overconfidence and Future Offending

The first column of Table 7, Panel A reports estimates for the pooled logit model using the HOHS group as the base category. Each of the other categories shows a higher and statistically significant probability of offending, which is expected since the HOHS represents the highest risk perceptions of any group, and thus most likely to be deterred. Yet, of considerable interest in this case is the comparison conditional on an individual having a high other perception, that is, the coefficient on HOLS, i.e., the overconfident group. This coefficient and odds ratio implies that, conditional on having high other risk, the odds of offending for individuals who also have low self risk are about 52% higher than those with high self risk. Operationally, this means that even for those would-be offenders who feel that the base rate of detection is high for the average offender, those with a high degree of overconfidence in their own criminal ability are considerably more likely to engage in offending.

* Table 7 about here *

We next fit a random effects logit model which is intended to capture the relative similarity of observations made on individual i. The second set of coefficients in Panel A report such results using HOHS as the base category. Notice that these results now represent subject-

specific coefficients, and each are smaller in magnitude that the pooled cross-section coefficients, yet are in the same direction and achieve comparable levels of significance. Again, consider the coefficient on HOLS, the overconfident group. This ratio can be interpreted as that the odds of offending are about 37% higher when individual *i* falls into the HOLS category relative to when the same subject falls into the HOHS category. Again, while this random effects estimate is smaller in magnitude, it still confirms the existence of an overconfidence effect.

If we condition on those with low other risk (i.e., those with a low perceived base rate of detection), we can also explore underconfidence. The first column of Panel B, reports the same pooled logit results this time using LOLS as the base category.[14] First, notice each of the coefficients is negative, meaning that the probability of offending decreases for each of the other categories relative to the LOLS group. Again, this is expected, since the LOLS group represents those with the lowest risk, and thus likely the least deterrable. Notice, however, that the coefficient for HOLS fails to approach a conventional level of statistical significance. This suggests that for those with a low self risk, there is no difference in the probability of offending between different levels of other risk. Yet the important coefficient in this panel is that on LOHS, which is negative and statistically significant. Specifically, this means that, conditional on perceiving low other risk, the odds of offending for those who have a high self risk are about 13% *lower* than for those who also perceive low self risk. In other words, for those who perceive a lower base rate of detection, there is a suppression effect on offending for being underconfident.[15]

Similarly, the results from the second set of coefficients in Panel B are the random effects estimates using LOLS as the base category. Again, the main coefficient of interest is for LOHS, which is marginally statistically significant ($p = .053$). This ratio can be interpreted as that the odds of offending are about 11% lower when individual *i* falls into the LOHS category relative to

when the same subject falls into the LOLS category, again, suggesting a reduction effect of being underconfident. In summary, while the random effects estimates are generally smaller in magnitude, they generally confirm the pooled logit results in each case.

Overconfidence and Future Arrest

As described earlier with respect to the financial management literature, overconfidence on the part of a decision-maker can often lead to unfavorable outcomes, such as achieving lower rates of return in trading stocks or bad investment decisions. From the perspective of an offender, the most unfavorable outcome is getting arrested, and bearing excessive risk, perhaps if one thinks that such risk is tangible for others but not themselves, is likely to produce a higher probability of arrest. Thus, Table 8 reports similar analyses as in the previous section, this time using arrest in period $t + 1$ as the outcome.

* Table 8 about here *

Panel A reports results using HOHS as the base category. Again, the main coefficient of interest is that of HOLS (high other – low self or the over confident). This odds ratio implies that, conditional on having high other risk, the odds of getting arrested for individuals who also have low self risk are about 27% *higher* than those with high self risk. This implies that for offenders who feel that the base rate of detection is high for the average offender, those who are overconfident in their own criminal ability are more likely to be arrested. Like the over confident stock trader, then, the price of over confidence for the criminal offender is an unfavorable outcome in the long term.

This result is confirmed by the random effects logit results reported in Panel A. Note that the subject specific estimates change very little from the pooled estimates in this case—the odds of offending are about 26% higher when individual *i* falls into the HOLS category relative to

when the same subject falls into the HOHS category, which once again yields an overconfidence effect.

Panel B shows results for the arrest outcome when LOLS is used as the base category. Again the coefficient of interest here is LOHS—if the coefficient is negative, this would imply that the probability of underconfident individuals being arrested would be less. Notice however that both the pooled logit and random effect logit coefficients on LOHS are quite small in magnitude, and neither even remotely approach conventional statistical significance. This absence of difference between LOLS and LOHS suggests that underconfidence, while associated with lower offending, does not appear to be associated with lower arrest.

In summary, our results confirm that overconfidence is associated with both higher likelihood of future offending as well as a higher likelihood of future arrest. Underconfidence in associated with a lower probability of future offending, yet is not associated with any differences in the likelihood of arrest. This null result of an inability to link underconfidence to arrest actually enhances the strong result linking overconfidence to arrest, as it suggests that some of the increased offending on the part of overconfident decision-makers is perhaps unwise and too risky, and reflective of a possible self-attribution bias.

DISCUSSION

Mark Twain once said, "It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so", implying that being overconfident about our knowledge, perceptions, or abilities can often lead us into making bad decisions. The literature in business and finance shows clearly just what kind of "trouble" overconfidence can lead to – the overtrading of common stocks, overpaying for corporate acquisitions, and having to engage in financial reporting fraud. This literature and additional studies in psychology and economics,

particularly behavioral economics, has also suggested both the fertile ground in which overconfidence grows (where the outcome is a low probability event and where the consequences of decisions are delayed) and for whom it is more likely to affect (males more than females, particularly young males). This literature seemed to suggest that feelings of overconfidence would be particularly important in understanding the commission of crime.

If the decision to commit a crime is based upon a consideration of the outcomes (both positive and negative) of the act, and the perceived probability of those outcomes occurring, it is reasonable to think that these probabilities could be substantially biased by feelings of overconfidence. If one thinks that they are better than others at avoiding apprehension, they would be likely to think that they have more ability in successfully committing crimes and would on average commit more crimes. The overconfident, therefore, would be at greater risk at committing crimes than the less confident. In fully explaining our hypothesis, we connected feelings of overconfidence to a self-serving attribution bias and a distortion in the updating of subjective assessments of the probability of crime risk.

We presume that most offenders start out with little understanding of their true ability to commit crime but with between-individual differences in a self-attribution bias which is the tendency to attribute successful outcomes to our skill and ability and failures to external causes or chance. We also presume that offenders are Bayesians and update their prior perceptions of the risk of apprehension for crime in response to new information such as a successful or unsuccessful crime. How Bayes' Rule is used, however, depends upon one's position on a continuum of self-attribution bias. When an offense is successfully committed those with higher levels of this self-attribution bias will presume that it is a signal of their ability to commit crime, while an unsuccessful crime will be due to a bad crime partner, an unusually vigilant victim, or just dumb luck. They will therefore overweight their successes and underweight their failures

[and likely overweight their successes more than they underweight their failures, (Gervais and Odean 1998)] when updating their perception of the risk or certainty of apprehension – and commit more crimes in the subsequent period. We argued that only with time and repeated failures will an offender's actual abilities begin to converge with his perceived abilities.

While we could not test all or even many of the empirical implications of our theory sketched here, we could test perhaps its central hypothesis – that there is a relationship between overconfidence and involvement in crime. Using two datasets, one from a "conventional" sample of high school students and the second from a sample of youth at-risk for serious crime, we found that feelings of being overconfident that one could commit a crime and get away with it, measured as the difference between the perceived probability of apprehension between the risk to one's self and to a generalized other, were pervasive for both common and serious crime. These feelings of overconfidence were also fairly stable over time. We also found in the Pathways serious offender sample that perceptions of overconfidence were significantly related to self-reported offending even after controlling for the level of risk. More specifically, while the coefficient for the relationship between risk perceptions and crime had the negative sign expected from deterrence and rational choice theory, net of that the coefficient for being overconfident had the positive sign we hypothesized. We also found that not only are overly confident persons more likely to offend, they are more likely to offend unwisely, resulting in a higher probability of being arrested.

In the beginning of our paper, we tried to situate our interest in overconfidence in a broader rational choice based theory that links individual differences like overconfidence and a self-serving attribution bias to the Bayesian updating of risk perceptions that offenders have repeatedly been shown to do. We have taken one small but important implication of our theory and subjected that to empirical test. Having found that being overconfident is positively related

to criminal offending, we would invite the field to investigate the other empirical implications of our theory. Among specific inquires we would encourage is whether there is a relationship between overconfidence and a self-serving attribution bias, whether in updating their perceptions of sanction risk those with a high self-serving bias overweight their successes and underweight their failures, whether this differential updating changes over time, and whether there are gender differences in self-confidence and how it relates to crime. Previous work in criminology has suggested that theories of individual differences can add a great deal to rational choice models of crime (Nagin and Paternoster 1993), and more generally work in cognitive psychology has added a great deal to and substantially modified the classical economic model (Camerer, Loewenstein, and Rabin 2004; Vohs, Baumeister and Loewenstein 2007). We would like to encourage this very kind of multi-disciplinary study of offender decision making (Nagin 2007).

Figure 1. Matrix of Self vs. Other Risk, Split by Median Values

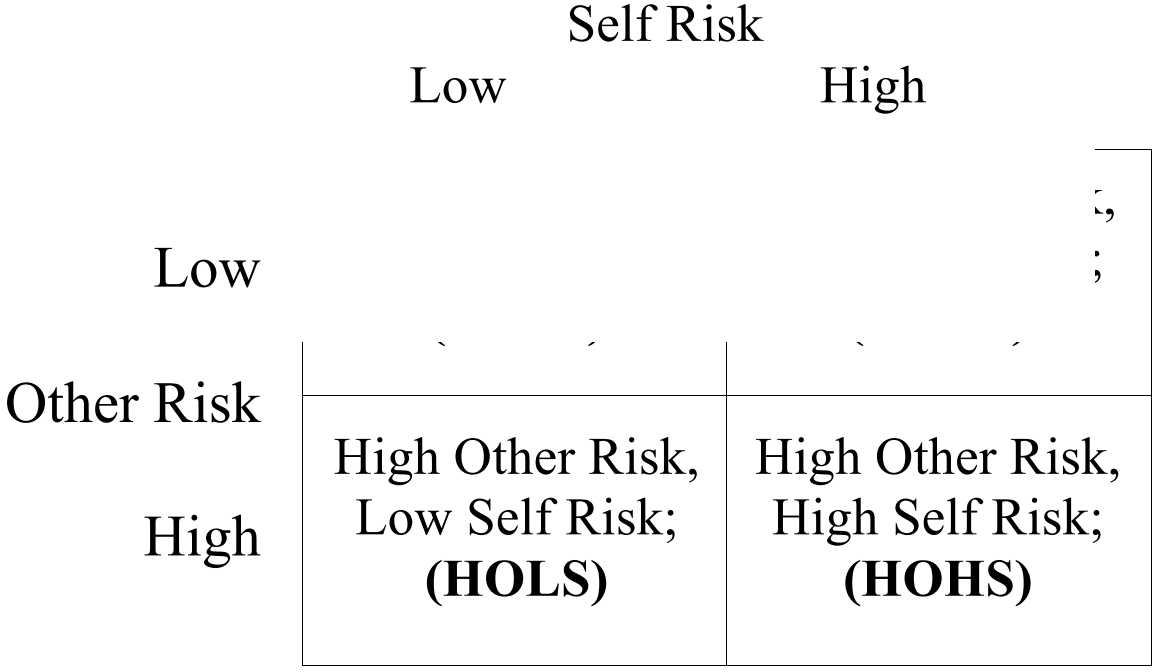

Table 1. Demographic Information for Samples

	High School Sample	Offender Sample
Gender (%)		
Male	51.1	86.4
Female	48.9	13.6
Race (%)		
White	83.7	20.2
Black	14.7	41.4
Hispanic	-	33.5
Other	1.6	4.8
Age at baseline	15.3	16.5
Age at First Arrest	-	13.8
No. of Prior Petitions	-	4.3

Table 2. Summaries of Self and Other Risk for High School Sample

Panel A - Self Risk

t	*N*	shoplifting	vandalism	drinking	smoking
1	2543	38.20	31.74	15.85	25.72
2	2152	35.05	30.69	13.48	21.34
3	2325	34.10	30.64	12.11	17.71

Panel B - Other Risk

t	*N*	shoplifting	vandalism	drinking	smoking
1	2561	33.93	29.72	20.94	27.24
2	2144	30.66	27.48	18.34	22.29
3	2329	28.96	26.77	17.15	19.26

Note: Risk Perceptions measured on a 0-100 scale.

Table 3. Summaries of Offending, Self, and Other Risk for Offending Sample

Panel A - *P*(Offending)

t	All Crimes	Aggressive	Income-Generating
1	0.560	0.522	0.271
2	0.475	0.439	0.218
3	0.425	0.386	0.204
4	0.380	0.346	0.173
5	0.317	0.280	0.141
6	0.315	0.277	0.127

Panel B - Mean Self Risk

t	All Crimes	Aggressive	Income-Generating
1	5.2	4.49	5.73
2	5.31	4.58	5.86
3	5.51	4.75	6.07
4	5.56	4.81	6.11
5	5.72	5.02	6.23
6	5.62	4.93	6.12

Panel C - Mean Other Risk

t	All Crimes	Aggressive	Income-Generating
1	5.44	4.62	6.05
2	5.44	4.65	6.03
3	5.58	4.82	6.14
4	5.57	4.83	6.12
5	5.6	4.87	6.15
6	5.48	4.77	6.00

Panel D - Arrest*

t	All Crimes
2	0.163
3	0.178
4	0.199
5	0.177
6	0.175
overall	0.178

Note: Risk Perceptions measures on a 0-10 scale
We are unable to match arrests with specific offenses, hence we cannot disaggregate them by aggressive vs. income-generating; also, since arrests in period 1 are not used in the analysis, we forgo reporting descriptive information here.

Table 4. Overconfidence in the High School Sample

t	*N*	mean	s.d.	*P*(OC)	*P*(Same)	*P*(UC)
			Shoplifting			
1	2509	4.06	31.57	0.382	0.194	0.424
2	2135	4.62	30.01	0.369	0.214	0.417
3	2308	5.18	29.42	0.342	0.235	0.423
			Vandalism			
1	2515	1.82	28.54	0.409	0.216	0.375
2	2137	3.27	26.01	0.387	0.238	0.375
3	2312	4.06	26.53	0.350	0.263	0.386
			Drinking			
1	2521	-4.78	24.81	0.525	0.239	0.236
2	2141	-4.73	21.99	0.505	0.276	0.220
3	2319	-4.87	22.42	0.505	0.295	0.201
			Smoking			
1	2487	-1.22	29.72	0.478	0.217	0.305
2	2112	-0.90	27.39	0.474	0.230	0.296
3	2297	-1.34	26.08	0.476	0.268	0.256

Note: *P*(OC), *P*(UC) denote % over, under-confident, respectively
***P*(Same) denotes % of individuals who report the same self, other risk perception**
Risk is measured on a 0-100 scale

Table 5. Overconfidence in the Offending Sample

Panel A - All Offending

t	*N*	mean	s.d.	P(OC)	P(Same)	P(UC)
1	1352	-0.27	2.33	0.480	0.109	0.411
2	1242	-0.24	2.35	0.486	0.117	0.398
3	1244	-0.12	2.23	0.451	0.120	0.429
4	1205	-0.07	2.23	0.423	0.144	0.433
5	1198	-0.02	2.14	0.406	0.164	0.431
6	1188	0.11	2.26	0.395	0.167	0.439
7	1196	0.14	2.18	0.378	0.166	0.456

Panel B - Aggressive Offending

t	N	mean	s.d.	P(OC)	P(Same)	P(UC)
1	1352	-0.23	2.39	0.458	0.192	0.351
2	1242	-0.13	2.43	0.436	0.205	0.359
3	1244	-0.07	2.30	0.423	0.216	0.361
4	1205	-0.07	2.34	0.404	0.214	0.382
5	1198	-0.02	2.21	0.394	0.252	0.354
6	1188	0.15	2.27	0.369	0.243	0.388
7	1196	0.16	2.27	0.365	0.261	0.374

Panel C - Income-Generating Offending

t	N	mean	s.d	P(OC)	P(Same)	P(UC)
1	1352	-0.29	2.63	0.449	0.161	0.390
2	1242	-0.32	2.60	0.450	0.168	0.382
3	1244	-0.17	2.50	0.413	0.193	0.394
4	1205	-0.06	2.45	0.393	0.207	0.400
5	1198	-0.01	2.36	0.369	0.235	0.396
6	1188	0.07	2.49	0.357	0.240	0.403
7	1196	0.12	2.39	0.339	0.220	0.441

Note: P(OC), P(UC) denote % over, under-confident, respectively
P(Same) denotes % of individuals who report the same self, other risk perception
Risk is measured on a 0-10 scale

Table 6. Logit Results for SRO as a Function of Self, Other Risk

	Panel A - All Offending				Panel B - Income-Generating Only				Panel C - Aggressive Only			
	I		II		III		IV		V		VI	
(other - self)	0.071	***			0.066	***			0.073	***		
	(0.013)				(0.014)				(0.013)			
other			-0.039	**			-0.069	***			-0.029	*
			(0.016)				(0.018)				(0.016)	
self			-0.091	***			-0.098	***			-0.095	***
			(0.013)				(0.014)				(0.013)	
intercept	-0.363	***	0.346	***	-1.463	***	-0.499	***	-0.518	***	0.062	
	(0.036)		(0.085)		(0.046)		(0.098)		(0.036)		(0.070)	
marginal effect - overconfidence	0.017	***	0.022	***	0.010	***	0.014	***	0.017	***	0.022	***
χ^{2}^			91.91	***			122.43	***			96.53	***

***, **, *** denote statistical significance at .10, .05, and .01 respectively.**
^ chi-squared value for the test of the null hypothesis H_0: $\pi_1 + \pi_2 = 0$.

Table 7. Pooled and Random Effects Logit Estimates for Offending Outcome

Panel A. HOHS as Base Category

	pooled logit*			**random effects logit**		
	coef. (s.e.)	OR	*p*-value	coef. (s.e.)	OR	*p*-value
LOLS	0.504	1.655	0.000	0.382	1.466	0.000
	(0.070)			(0.088)		
LOHS	0.259	1.296	0.006	0.176	1.193	0.148
	(0.094)			(0.122)		
HOLS	0.417	1.517	0.000	0.313	1.367	0.014
	(0.103)			(0.127)		
intercept	-0.733		0.000	-0.868		0.000
	(0.053)			(0.071)		
var(u_{it})	-			2.516		0.000
Log L	-4056.340			-3698.368		
N	6,154			6,154		

Panel B. LOLS as Base Category

	pooled logit*			**random effects logit**		
	coef. (s.e.)	OR	*p*-value	coef. (s.e.)	OR	*p*-value
LOHS	-0.254	0.776	0.008	-0.237	0.789	0.053
	(0.096)			(0.123)		
HOLS	-0.096	0.908	0.329	-0.091	0.913	0.468
	(0.099)			(0.123)		
HOHS	-0.608	0.545	0.000	-0.504	0.604	0.000
	(0.072)			(0.088)		
intercept	-0.220		0.000	-0.459		0.000
	(0.052)			(0.071)		
var(u_{it})	-			2.464		0.000
Log L	-4040.371			-3691.598		
N	6,154			6,145		

*** standard errors are clustered at the individual level**

Table 8. Pooled and Random Effects Logit Estimates for Arrest Outcome

Panel A. HOHS as Base Category

	pooled logit*			**random effects logit**		
	coef. (s.e.)	OR	*p*-value	coef. (s.e.)	OR	*p*-value
LOLS	0.297	1.345	0.000	0.241	1.272	0.004
	(0.077)			(0.085)		
LOHS	0.179	1.196	0.105	0.159	1.173	0.200
	(0.110)			(0.125)		
HOLS	0.238	1.268	0.045	0.227	1.255	0.077
	(0.119)			(0.129)		
intercept	-1.675		0.000	-1.911		0.000
	(0.056)			(0.066)		
var(u_{it})	-			0.899		0.000
Log L	-3166.062			-3100.305		
N	6,770			6,770		

Panel B. LOLS as Base Category

	pooled logit*			**random effects logit**		
	coef. (s.e.)	OR	*p*-value	coef. (s.e.)	OR	*p*-value
LOHS	-0.064	0.938	0.559	-0.036	0.965	0.775
	(0.110)			(0.124)		
HOLS	-0.005	0.995	0.963	0.033	1.033	0.795
	(0.117)			(0.127)		
HOHS	-0.258	0.773	0.001	-0.198	0.821	0.021
	(0.077)			(0.086)		
intercept	-1.432		0.000	-1.720		0.000
	(0.052)			(0.067)		
var(u_{it})	-			0.906		0.000
Log L	-3168.298			-3101.662		
N	6,770			6,770		

*** standard errors are clustered at the individual level**

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NOTES

[1] "Dirty Harry" Callahan to Lieutenant Briggs in the movie *Magnum Force*.

[2] Although there exist no empirical investigations of overconfidence in criminology, there is some related qualitative work. For example, when probing armed robbers about how they handled the threat of legal consequences, Wright and Decker (1997) interviewed one robber who said (p.119): "I try to keep [thoughts about getting caught] out of my mind. I look at it more on a positive side: getting away. A lot of times it enters my head about getting caught, but I try to kill that thought by saying I can do it; have confidence in pulling the job off. (No. 01)". Another robber (p.122) held an inflated opinion of his skill at avoiding detection largely through his criminal expertise: "What I'm really trying to say [is that] if you good at what you doing, you don't care too much cause you figure nine times out of ten you not gonna get caught. (No. 62)." A similar theme to emerge comes from Tunnell's (1992) interview with a 33-year old burglar serving his third prison sentence. When asked if he worried much about getting caught while he was doing them, he replied "No…No-o-o. I didn't give a damn. And the police couldn't catch a damn cold if it wasn't for the snitches" (p.89).

[3] A related study showed that adult business executives display hubris, or the exaggerated sense of self that leads them to believe that they can control many (business) events out of their control. Piquero et al. (2005) found this desire-for-control to be important in decisions to engage in corporate crime.

[4] It is important to point out that this is by no means a perfect measure of overconfidence. Some of the discrepancy between an individual's self and other perceptions could theoretically be the result of other factors, including an experiential effect from belief updating of one's own perceptions instead of in general. Nonetheless, it is reasonable to conclude that, since the true detection probabilities are rarely known with any certainty anyway, this discrepancy is at least a reasonable proxy for how much better (or worse) an individual perceives himself or herself in relation to their ideal of the 'average' offender.

[5] Another possible interpretation of an individual providing a lower self risk than other risk might be due to the individual having private information regarding his or her level of skill or ability, rather than this individual being overconfident. Yet, we feel this interpretation is less likely for two reasons. First, while it is taken for granted in most perceptual studies that self risk is subjective quantity, note that other risk, i.e., the offender's best guess of the base rate of detection, is itself a subjective quantity. Therefore, when forming a perception of one's own distance from a base rate (that a knowledgeable skilled or 'better' offender would have), there is simply no objective metric with which to compare and hence no way to know how much more skilled they actually are. Furthermore, the offender's perception of other risk would likely be from a local, rather than global, reference group such as one's peers where such information is biased anyway. The second point in favor of interpreting what we measure as overconfidence rather than 'skill' deals with the arrest outcome. As we show below, not only are overconfident offenders are more likely to offend, but they are also more likely to get arrested as well. If they were truly 'better' or more skilled offenders, we should expect either no difference or a lower arrest rate, not a much higher one like we find. Nonetheless, we take steps through our empirical analysis to ensure that an individual's perception of the base rate of detection is properly controlled for.

[6] Ideally, we would have examined the association between overconfidence and offending in this high school sample, as we do in the serious offending sample. However, given extremely large amounts of missing data (mainly from item non-response) on survey questions dealing with offending, any such analysis would be extremely problematic and ultimately futile. For instance, nearly 1/3 of the sample failed to answer the questions about engagement in any offending activity (e.g., vandalism, shoplifting) at the first interview. Given such problematic data limitations with the offending questions, we restrict our analysis of the high school sample strictly to descriptions of overconfidence in risk perceptions associated with these crime types.

[7] Note that in the non-offending sample, risk perceptions were measured on a 100-point scale, while in the non-offending sample, perceptions were measured on a 10-point scale, and as such, the standard deviations differ by a factor of 10. Otherwise, they have similar interpretations.

[8] Two points on estimation warrant mentioning. First, in all models the standard errors are cluster-corrected at the individual level to ensure proper inference. Second, since our purpose is to merely demonstrate an association

between overconfidence and offending, risk and offending are measured contemporaneously. We recognize that in an explanatory model of risk and offending, it is clear that to preserve the temporal ordering necessary to test for deterrent effects, current offending should be regressed on a lagged value of risk (Paternoster, 1987). However, in the present case we are merely interested in documenting that association between these two variables exists, and thus we do not speculate on a causal model, given as to how there is likely a large amount of bidirectionality in determining the levels of either quantity for any individual. We do speculate on some such ideas in the discussion section.

[9] Here the term 'marginal effect' simply refers to the quantity ∂P[offending | OC]/∂OC, or the change in the probability of offending with respect to a change in overconfidence, and it is used simply to provide a meaningful interpretation to the logit coefficients. We do not mean to imply that this quantity represents an actual treatment effect.

[10] This decision lag the risk variables results in the loss of one period of data (meaning we now consider only $t = 5$ periods instead of 6), since we now are able to only use risk from the first 5 periods and offending and arrest data from the last 5 periods.

[11] The median of self risk in the Pathways data is 5.28 and the median of other risk is 5.43.

[12] Although we have spoken of and measured overconfidence as a continuous variable (see equation 1.0), we conceptualize it here in categorical terms for the following reasons: (1) it is easier to grasp the probabilities on the "other" margin than in a continuous framework, (2) the probabilities in the categorical cases are more straightforward to interpret for changes in rates as opposed to marginal effects, and (3) the results are confirmed when we used overconfidence as a continuous variable.

[13] Readers may wonder why we choose not to compare probabilities at the margins as well. We note that this comparison, which yields overwhelming evidence that P(offend | LS) > P(offend | HS) and P(offend | LO) > P(offend | HO), is merely demonstrative of an oft-discussed certainty effect in deterrence literature and has been demonstrated within several prior studies using these data.

[14] The results in Panel B are presented merely to allow for an easy presentation of the coefficients and odds ratios for a comparison between LOLS and LOHS, and are not meant to imply that this model is substantively different than that reported in Panel A.

[15] We can also compute probabilities from these values to better illustrate the pooled logit results in Panels A and B. Specifically, P(offend | HOLS) = .422 > P(offend | HOHS) = .304, or in other words, P(offend) is about .12 higher for overconfident individuals. Similarly, P(offend | LOHS) = .384 < P(offend | LOLS) = .443, or P(offend) is about .06 lower for underconfident individuals.