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I, Sultan Altikriti, hereby submit this original work as part of the requirements for the degree of Doctor of Philosophy in Criminal Justice.

It is entitled:

**The effects of individual differences on the perceived risks and rewards of offending: A meta-analysis**

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**The effects of individual differences on the perceived risks and rewards of offending: A  
meta-analysis**

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## Abstract

The rational choice perspective has a storied history dating back to the enlightenment period of the 1700s. In criminology, the perspective has undergone several revisions, testing, and iterations. One of the more recent lines of research in this perspective is the merger of individual factors with perceptions of risk and reward. With some exceptions, the rational choice perspective has traditionally viewed offenders as rational beings who deliberate over the risks and rewards of crime. Several lines of research, however, have illustrated the influence of individual differences on the assumed rational processes. Although expanding, the conflicting body of research on the influence of individual traits on risk and reward has yet to arrive at a consensus. The current project subjects this body of research to a meta-analysis to address a) whether individual differences, as a whole, affect perceptions of risk and reward, b) which specific individual differences influence perceptions of risk and reward, and c) the aspects of study design that influence the associations between individual differences and perceptions of risk and reward. Overall, the meta-analytic results from  $n = 178$  estimates derived from  $k = 22$  studies suggested that several individual differences influence perceptions of risk, social costs, and rewards. Pooled estimates of individual differences with fewer constituent estimates, however, were more varied and often not significant, suggesting the need for more research for those particular topics to derive more precise estimates. Additionally, the results suggested that individual differences have more of an impact on perceptions of risk among younger samples and less of an impact on rewards among older samples. These distinctions converge with research on adolescent development and desistance theories. The implications of the current project include summarizing a body of research that has yet to be systematically assessed, informing broad criminal justice policies that rely on deterring offenders, and providing a path for future research on the influences of perceptions of risk and reward.



## **Dedication**

This project is dedicated to the things that made it possible and those that made my time during it wonderful.

My mom and dad gave up a lot for me. They sacrificed home and livelihood to bring me and my brother here. I owe them a debt of gratitude I can never repay.

America has many faults. Despite that, my parents decision to bring me here altered the trajectory of my life in incredible ways. I owe this place a debt that I will begin to repay monthly.

To my Claudi. You've been there for me during a difficult time and have made it entirely wonderful and happy. I cherish these years and look forward to many more. I owe you a debt that I will be expanding in the years to come.

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## Chapter 1: The Problem

### Statement of the problem

Across a range of methods, estimates of the costs of crime in America range annually from \$450 billion to \$3.41 trillion (Cohen, 2000; U.S. Government Accountability Office, 2017; Wickramasekera et al., 2015). Beyond the monetary toll, there is also a psychological and human toll (Viscusi, 2000). Of all the expenses related to crime, however, the one most directly affected by policy decisions is the response to crime. Of the total costs of crime in the US, nearly \$280 billion is accounted for by expenditure allocated to responses to crime (Kyckelhahn, 2015). This amount includes spending on policing, corrections, and the court system. Although crime control is an essential function of society, whether the crime-control expenditure is spent effectively is unclear (Nagin, 2013b).

The American criminal justice system relies on the Classical School notion that punishment controls crime (Paternoster, 2010). Specifically, the current criminal justice system relies on punitive measures that leverage risk of sanctions to deter crime, underpinned by the assumption that potential individuals are rational in their decision to offend, weighing both costs and rewards prior to offending. Among other goals, one of the main objectives of the criminal justice system is to use the threat of sanction to increase penalties and reduce incentives in hopes of persuading potential offenders from offending and to discourage recidivism. The reliance on punitive measures and sanctions, however, became a source of contention as the prison system expanded exponentially in the latter half of the 20<sup>th</sup> century (Clear, 2007; Garland, 1991).

Whether such a crime control policy can be sustained at least partially relies on the underlying assumption that potential offenders are rational and deterrable (Jacobs, 2010). With this background, much of the changes in broader policy toward more punitive carceral practices can be seen as an effort to either deter offenders from crime, incapacitate them, or both. This process is typically recognized in two forms: Specific deterrence is concerned with the

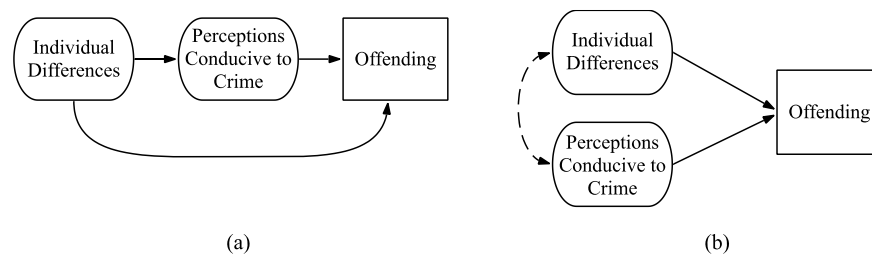
punishment of an individual to influence future offending behavior, whereas general deterrence aims to prevent offending from others through vicarious example and the threat of punishment (Nagin, 2013b). An example of this policy occurred the second half of the 20<sup>th</sup> century, where sweeping changes made the criminal justice system more punitive (Carroll & Cornell, 1985; Fagan & Meares, 2008; Raphael, 2009; Raphael et al., 2009). Incapacitation was relied on to isolate offenders from the general population, ostensibly preventing further offending opportunity (for a counterpoint, see DeLisi, 2003) and dissuading others from offending. The combined effects of incapacitation and deterrence—both specific and general—was intended to mitigate the rising crime rate, although research on the efficacy of these measures is mixed (Nagin, 2013b; Raphael et al., 2009), with some evidence of conditional effects (Jacobs, 2010; Pogarsky, 2002).

Deterrence and rational choice theories have been the focus of much empirical investigation since Becker's (1968) seminal work on the utilitarian approach to offender decision making. Becker rejuvenated interest in the rational choice model after much of the early 20<sup>th</sup>-century research focused on personal characteristics and macro-level theories of crime (Nagin, 2013b; Paternoster, 1987). A voluminous literature has since estimated the effects of deterrence on offending and analogous behavior, including several reviews and meta-analyses conducted to contextualize these findings (Baker & Piquero, 2010; Dölling et al., 2009; Nagin, 2013a; Pratt et al., 2006). Findings on this front have concluded that components of deterrence (e.g., risk, reward, social costs) were correlated with offending and deviance (Dölling et al., 2009), at least for certain segments of the population.

Overall, however, deterrence does not seem to have a uniform impact across individuals likelihood of offending (Bouffard et al., 2018). Some individuals appear to be easily deterred, while others appear less deterrable (Pogarsky, 2002). The emergent research on deterrability—the differences across individuals in response to deterrence—has received less attention relative

to the other side of the equation—the relationship between perceptual deterrence and offending outcomes. In reality, however, if individual differences (IDs) influence perceptual deterrence, then these factors should be taken into account (Pratt et al., 2006). Although the perceptual deterrence → offending relationship has been empirically assessed through meta-analysis, the antecedent IDs → perceptual deterrence relationship has not. Recently, however, studies have begun to assess the effects of individual characteristics on elements of perceptions of risk, social costs, and reward. These factors are referred to as perceptions conducive to crime, or PCC, in the current project. This line of research is also important to disentangling the multiple ways that IDs and PCC can be related. For example, Panel A in Figure 1 displays a mediating relationship where IDs influence the formation of PCC, while Panel B suggests that IDs are only related to PCC through their mutual relationship with the offending outcome. Appropriately specifying these relationships is critical in guiding future research.

Figure 1: Two potential ways that individual differences, perceptions conducive to crime, and offending may be related.



As this body of literature grows, it becomes critical to systematically assess and estimate the antecedent influence of IDs in PCC (as illustrated in Figure 1 Panel A) for at least two reasons. First, estimating the patterns of influence between IDs and PCC helps guide future research and better specify tests of rational choice, deterrence, and deterrability. Second, and more broadly, contextualizing these findings within the backdrop of criminal justice system policies sheds light on whether a unilateral policy approach based on deterrence stands on empirical and logical ground. If the relationship between IDs and PCC is effectively nonexistent,

then it can be argued that uniform deterrence policies are efficient in influencing offending behavior. However, if IDs influence PCC, then a more individualized response to crime, including treatment of developmental factors contributing to skewed PCC, is warranted.

### **Current Project**

The reemergence of rational choice and deterrence theories in criminology research is at least partially due to the work by Becker (1968) and by Cornish and Clarke (1986) on offender decision making. Subsequently, research on deterrence assumed that offenders are rational in their pursuit to maximize gains and minimize costs in making offending decisions. Numerous studies have since tested and challenged this idea of rational offenders (e.g., Bouffard et al., 2018; Jacobs, 2010; Schulz, 2014; Thomas et al., 2013).

Although not an exhaustive list, the proposed influences on deterrability span several domains, including maturity and age (Bushway et al., 2013; Freeman et al., 2017; Lee et al., 2018), gender (Carmichael et al., 2005; Freeman et al., 2017), community and neighborhood influences (Kim et al., 2014), peer influence (Paternoster & Piquero, 1995; Schepers & Reinecke, 2018), prior experience (Schulz, 2014; Wilson et al., 2017), morality (Gallupe & Baron, 2014; Grasmick & Bursik, 1990; Pauwels et al., 2018), self-control (Hirtenlehner et al., 2014; Nagin & Pogarsky, 2006; Paternoster, 1987; Pauwels et al., 2011), and executive functioning (Séguin et al., 1999). Given the state of the literature, there is sufficient evidence to suggest IDs may influence PCC, and that these differences could affect the relationship between PCC and offending. Even so, there is a lack of consensus regarding the factors that consistently influence PCC.

With such a broad literature on the varying predictors of deterrability, it is unclear which have an impact and under what circumstances. Although numerous studies have assessed the effects of IDs on PCC, the variety in predictor and outcome variables, contextual differences, sample variability, and heterogeneity in the results require a systematic review and empirical

appraisal of the state of the literature. To date, however, there have been no empirical assessments of the literature on association of IDs and PCC. Further, no studies have assessed which specific IDs affect specific PCC. Organizing this body of knowledge removes some of the ambiguity around the influences of deterrability. Beyond organizing the literature, however, a meta-analysis of the extant findings provides an empirical assessment of the state of the literature. To this point, the focus of the current project is to review and meta-analyze the literature from relevant studies. The current project also seeks to organize this growing body of work by summarizing the estimates of the purported predictors of perceptions of risk and reward.

### **Research Questions**

Deterrence and rational choice are among the most prominent perspectives of offending (Thomas & Loughran, 2014). Assessing the intersection of rational choice and deterrence with theories on IDs and offending is critical for advancing both perspectives. Doing so allows research to guide effective criminal justice policy and intervention rather than relying on a blanket punitive-oriented approach. To its most fundamental point, the current project poses three research questions:

- 1) Do individual differences (IDs) systematically influence the PCC across individuals?
- 2) Which IDs predispose some individuals to differential levels of PCC?
- 3) Do the observed relationships vary across study characteristics?

Although these questions have clear implications for theories of offending (i.e., rational choice theory and developmental theories), the more salient consequence of asking these questions relates to policy implications. If offenders, and especially serious offenders, are less amenable to the threat of punishment—are less likely to perceive and react to risk—then how can a system built on these assumptions be effective?

### **Outline of the Current Project**

Rational choice and deterrence theories do not belong neatly into one discipline. These



theories draw on inspiration from philosophical, sociological, psychological, and criminological sources (Cornish & Clarke, 1986). Rational choice theories are also intimately intertwined with economic theories of behavior. Economics, however, tends to streamline theories to a calculus of risk and reward, valuing parsimony over theoretical intricacy (Dhimi, 2016). To encompass the elements from philosophy, sociology, and psychology, a more comprehensive framework is needed. Although individual studies have tested the associations between numerous predictors of risky behavior and reward salience, revealing influences from genetic (Strawbridge et al., 2018), personality, and environmental characteristics, there have not been any systematic reviews of the influences of IDs on PCC. Given the salience of perceptions of risk and reward for current criminal justice policies, the dearth in consensus regarding predictors of risk reveals an important gap in the literature. An empirical appraisal of the literature to date can be informative to future research on IDs and deterrence and informative to criminal justice policy. The following paragraphs outline the remainder of the project.

Chapter 2 provides an overview of the origin, historical progression, and current landscape of deterrence and rational choice. In the first section of this chapter, the theoretical origin of deterrence theory is discussed, along with the logical and conceptual arguments that underpin it, dating back to the 1700s. Subsequently, renewed interest in deterrence theory, appearing in the mid-19<sup>th</sup> century is then discussed. In this section, salient work that reignited interest in deterrence theory after a long period of dormancy are reviewed. These works brought a new age for deterrence theory research by reframing deterrence from idle theorizing to an empirically testable scientific theory leading to an outpouring of empirical testing in the late 19<sup>th</sup> century. Finally, the current state of deterrence theory is discussed in the third and final section. Here, empirical studies on deterrence and deterrability are reviewed, with an emphasis on studies that have begun to incorporate the influences of IDs on the PCC.

Chapter 3 focuses on the meta-analytic process. In this chapter, the goals of meta-

analysis, to summarize and organize a growing body of research, are discussed. Further, the advantages and disadvantages of using meta-analyses to synthesize a body of research are reviewed. The chapter concludes with a review of how meta-analyses are conducted and a brief account of the methodological choices made in the current project. Chapter 4 provides a detailed exposition of the methods employed in the current project.

Chapter 4 discusses the methods used in the current project. This chapter outlines the data collection process, including the literature search and study collection. This chapter also details the coding process for each study and the estimates derived from the selected literature. Finally, this chapter outlines the analytic plan in terms of conducting the meta-analyses and additional analyses such as assessments of heterogeneity, moderation, subgroup analyses, and tests of publication bias.

Chapter 5 reviews the results in four sections. The first details the main pooled estimates derived from the overall effects of IDs on PCC. The second, third, and fourth sections assess the effects on perceptions of risk, social costs, and rewards, respectively. Within each of those sections, assessments of heterogeneity, moderation, subgroup analyses, and publication bias are conducted to further contextualize the results.

Chapter 6 discusses the previous chapter's results regarding their substantive meaning, the significance for research, treatment, and policy, and the limitations of the current project. In this chapter, the overall findings relating to the association between all IDs and perceptions of risk, social costs, and rewards are discussed. Finally, each the results relating to each PCC is discussed in more detail.

Chapter 7 provides the conclusion to project and summarizes the objectives and findings herein.

## Chapter 2: The Literature

### Origin

Punishment in response to offending is driven by various factors, including preserving and enforcing moral and social order (Garland, 1991), political motivations (McBride, 2007), retribution, incapacitation, and rehabilitation (Alschuler, 2003), and deterrence (Wright, 2010). The latter factor, deterrence, can be traced back to the work of utilitarian philosopher Cesare Beccaria, published in 1764, setting the roots for deterrence theory from a legal perspective (Paternoster, 2010). In this work, Beccaria aimed to increase the legitimacy, judiciousness, and effectiveness of the legal system. Following Beccaria, Jeremy Bentham's seminal work, published in 1789, articulated a more complete theory of offending, setting up the foundation for the rational choice perspective and deterrence related to crime (Paternoster, 2010). Here, Bentham argued that offending has utility in that individuals seek to minimize pain and maximize pain (Paternoster, 2010).

Beccaria and Bentham posited that crime is driven by inherent human self-interest and must be controlled through the use of punishment proportionate to the offense. In responding to the overly punitive systems in place at the time, these Enlightenment-era scholars posited penalties for offending need not be overly punitive, but just severe enough to deter self-interested acts of crime. Bentham, however, contended that crime prevention through deterrence is preferable to punishing offenders after offending (Paternoster, 2010), stating that "it is better to prevent crimes than to punish them" (Beccaria, 2016, p. 92). Thus, a relatively simple postulate of offending underpins the deterrence framework: as benefits of offending begin to outweigh costs, offending becomes more likely (Pratt et al., 2006). As a consequence, deterrence can be viewed as a tool for preventing potential offending through the threat of punishment by sanction. Broadly, this perspective assumes that individuals are rational to an extent and responsive to risks and incentives of offending behavior. Deterrence, therefore, relies on the perceptual

processes of risk and reward calculation regarding offending, where increasing punishment and decreasing rewards, should reduce offending likelihood. Consequently, the goal is to make crime less appealing to potential offenders by increasing risks of punishment and decreasing expected rewards, resulting in lower aggregate levels of offending (Nagin, 2013a).

Under this perspective, offending has utility in that it can provide rewards in the form of pecuniary and nonpecuniary gains, but also carries with it the potential for punishment (Cohen, 2000). Generally, rewards encompass elements of personal thrill, financial gain, increased social status, and other perceived benefits (Nagin et al., 2015), whereas risk includes aspects such as social costs, potential for physical injury, or legal sanctions, which factor into the perceived certainty and severity of punishments (Nagin et al., 2015). In contemplating offending, the assumption is that individuals consider these elements of risk and reward as part of the offending calculus (Paternoster, 1987; Pratt et al., 2006). Therefore, deterrence, refers to the mental processes that are undertaken when offending decisions are deliberated.

Following early work on deterrence, the perspective gained in popularity, becoming one of the dominant explanations of offending and a central component of the criminal justice system (Paternoster, 2010). The deterrence perspective waned in popularity, however, in the early 1900s, with scholars largely following the positivist perspective, focusing on individual differences, and the sociological perspective, focusing on the social influences of offending (Paternoster, 2010; Pratt et al., 2006). The shift was at least partially due to the changing zeitgeist of the time and reduced emphasis of a punishment-oriented criminal justice system relative to a preference for treatment and rehabilitation (Paternoster, 2010).

### **Reemergence**

Following a period of reduced focus on deterrence research, two scholars from alternative backgrounds produced work that would renew interest in deterrence research. Through their reformulation of the original ideas in deterrence theorizing, the first scholar, Becker (1968),

building on an economics framework of expected utility, argued that individuals are rational and self-interested (similar to Beccaria's contention), where offenses are a result of differing benefits and costs of crime across individuals who seek to maximize utility (avoid pain and increase pleasure). Specifically, when the utility of crime (the balance of benefit and reward) outweighs law-abiding behavior, offending is likely.

The second scholar, Gibbs (1969), building on a sociological framework, expanded on Beccaria's argument that the certainty and severity of formal punishment reduce offending. In this effort, Gibbs assessed whether there was an association between crime rates and aspects of formal punishment across states, finding that states with higher certainty of punishment exhibited lower homicide rates. The contributions of Becker and Gibbs were pivotal in that they cleared a path for the empirical tests of deterrence. Subsequently, Ehrlich (1973) assessed the association between deterrence factors (certainty and severity of punishment) and offending, finding support for deterrence and an inverse relationship with crime rates. A raft of qualitative and quantitative research followed supporting—and at times contradicting—elements of the deterrence perspective, each building toward an increased need for empirical appraisal of the literature (i.e., meta-analysis).

### **Empirical Standing**

As observed by Gibbs (1969), although objective measures of deterrence were found at the macro-level (i.e., clearance rates or severity of sanctions across states), individuals differed in their perceptions of deterrence. This distinction prompted a new line of research on perceptual deterrence, beginning with scholars such as Geerken and Gove (1975) who argued not whether deterrence affects offending but under what conditions. Decker et al. (1993) echoed this notion, remarking that the link between objective risks and offending is indirect and flows, at least partially, through the subjective perceptions of the individual. Numerous studies have since assessed how perceptual deterrence, as measured by certainty and severity (and occasionally

celerity), is associated with offending. Two prominent reviews of this literature emerged.

A systematic review of the literature conducted by Paternoster (1987) concluded that there is mixed evidence for deterrence theory in explaining self-reported general offending, minor offending, and drug use, with the bulk of support being for the certainty of punishment (i.e., the respondents perceived risk of apprehension subsequent to offending). Paternoster further contended that studies varied in their conclusions across different methodologies. A more recent meta-analysis by Pratt et al. (2006) assessed the state of the literature regarding deterrence and offending from a sample of 40 studies that yielded 200 estimates of the effects of deterrence on offending. The meta-analysis reached five central conclusions related to deterrence. First, the effect sizes derived from these estimates was modest, ranging from  $r = 0$  to  $r = -.20$ , suggesting either null or negative relationships between deterrence (i.e., certainty, severity, or non-legal sanctions) and offending. Notably, Pratt et al. (2006) find that perceived certainty of punishment—typically operationalized as respondents' perceived odds of apprehension—exhibited the highest empirical support, corroborating previous research on the topic (e.g., Paternoster, 2010; Pogarsky, 2002). Pratt et al. suggested that the modest findings were due to the complex nature of offending behavior, which cannot be reduced to one theory (i.e., deterrence). The authors contended that other theories of crime outside the boundaries of deterrence theory contribute to explaining offending. The second conclusion, an extension of the first, suggested that once relevant control variables from other theories are accounted for, the estimates for the association between deterrence and offending is considerably weakened. From this finding, the authors contended that the relationship between deterrence and offending is at least partly due to misspecified models that do not account for competing individual-level theories of crime (e.g., self-control and peer influence).

The third conclusion of Pratt et al.'s meta-analysis was that an assortment of the methodological variation across studies indicated support for deterrence theory in the literature is

highly contingent on study design, control variables, and samples used. Notably, however, the authors observed decreased empirical support for deterrence theory within studies of higher methodological rigor. Fourth, the authors concluded that deterrence theory on its own is limited in its capacity to explain general behavior. Therefore, deterrence theory should be limited to explaining certain offense types (e.g., white-collar or property) as a specific theory of offending rather than a general theory. The fifth and final conclusion is most relevant for the current project. The authors argued that for deterrence theory to remain relevant within the confines of criminological theorizing, these empirical shortfalls must be addressed. One of the suggestions provided is the assessment of how IDs and situational characteristics can influence aspects of perceptual deterrence. The authors caution, however, that such integration risks the simplicity and parsimony inherent in the deterrence perspective. Nonetheless, assuming that offenders are rational risks misspecifying studies of deterrence if offenders are instead subject to their individual biases in calculating risk and reward. This is not a new proposition, as Beccaria in the 1700s acknowledged that risks and rewards are calculated differently across individuals.

### **New directions**

Since the meta-analysis by Pratt et al. (2006), there have been numerous attempts to integrate deterrence with other theories. Perhaps one of the most notable of these works is the distinction between deterrence and deterrability as discussed by Jacobs (2010). In distinguishing between deterrence and deterrability, Jacobs asserts that deterrability is the capacity and willingness to consider factors of deterrence related to offending. More specifically, this calculation refers to individual heterogeneity that influences risk and reward calculation. Consequently, “deterrence hinges on offenders who are deterrable” (Jacobs, 2010, p. 420), whereby some individuals may not adequately perceive the risk of offending independent of the objective risks. This formulation views deterrability as the contemporaneous effect of characteristics (e.g., IDs) on the effects of perceived risk and reward on offending (i.e.,

moderation effects). However, Jacobs's view that "deterrability describes the capacity or willingness of the would-be offender" to weighing risks and rewards does not preclude longitudinal processes where factors such as IDs influence the formation and capability of would-be offenders.

Pogarsky (2002) specified three distinct groups of individuals with varying responsiveness to sanction threat. The first, acute conformists, conform regardless of sanction threat. These individuals consider the law with high moral regard and are less likely to offend in the first place. Therefore, perceptual deterrence should not influence offending among this group as there is little offending to predict. The second group, the incorrigibles, offend at higher levels and are resistant to deterrence factors. Again, deterrence factors would seem useless in influencing offending behavior for this group as they are unaffected by these risk factors. The final group was labelled the deterrable offenders, whose offending is contingent on perceptual deterrence factors. This group is more likely to offend if the perceived risks are low and alternative options to offending exist.

The definition of rationality is far too broad and complex for the current project to grapple with completely. However, a brief conceptualization of rationality, and irrationality, must be offered in order to assess personal bias and skewed perceptions within rational choice theory. Within the context of the current project, and as assembled from the criminology literature, a conceptualization of rationality used herein is the impartial assessment of the potential risks and rewards of offending. More precisely, given identical information about the risk and reward of an offense, individuals who systematically vary around the objective risks and rewards as a result of individual differences are less rational.

Along this line of research, studies have begun to examine the influence of IDs on perceptions of risk and reward (e.g., Altikriti & Nedelec, 2020; Pickett et al., 2018; Piquero & Tibbetts, 1996). These studies reason that situational factors are not independent of individual



traits and developmental factors and that developmental factors may influence offending indirectly. Specifically, these studies maintain that there is a processual element to offending that links distal developmental characteristics (e.g., self-control) and proximal factors of perceptual deterrence. Although these studies are relatively new, this area has expanded recently to a sizable body of research. The research in this area spans influences from psychology, sociology, and developmental criminology in affecting perceptual deterrence. While there is a growing number of studies on the topic, with various samples, independent variables, and other methodological variations, there is little consensus across findings. Further, although there are several reviews and empirical summaries of the effects of deterrence on crime (see Paternoster, 1987; Pratt et al., 2006), there are no empirical assessments of the research on effects of IDs on PCC. To this point, there is currently no consensus on the empirical association between IDs and PCC, an important gap to address for the field to move forward. One study by Piquero et al. (2011) appraised the literature of variation across individuals in perceptual deterrence. This review finds support for various relationship between IDs (e.g., morality, self-control, and social networks) and PCC, concluding, “criminologists should develop and empirically assess the origins and sources of variation in the preferences and constellation of risk/reward (Piquero et al., 2011, p. 356). The research related to IDs and perceptual deterrence has since expanded sufficiently to warrant organization and appraisal of the overall effects, providing grounds for a meta-analysis to assess the current standing and guide future research. The IDs reviewed in the sections below are derived from criminological research, such as the review by Piquero et al. (2011), that provided a good account of some of the prominent criminological IDs (i.e., self-control, peers, and morality). Additional IDs were derived from recent criminological and psychological research include executive function (Appelt et al., 2011; Nigg, 2017), psychopathy (Altikriti & Nedelec, 2020; Swogger et al., 2010), and emotions (Roche et al., 2020; van Gelder & de Vries, 2012).

### **Individual Differences and Perceptual Deterrence**

Criminal propensity is one of the most studied aspects of individual predictors of offending (Jacobs, 2010). Criminal propensity refers to population heterogeneity (i.e., individual differences or IDs) that influence offending. Typically, these factors are relatively stable across time and influence offending patterns over time (Altikriti et al., 2020). Perhaps said best by Becker: “Forward-looking behavior, however, may still be rooted in the past, for the past can exert a long shadow on attitudes and values” (1993, p. 386). The following sections discuss some of the salient IDs that have been associated with offending, and how they relate to PCC.

### **Self-control**

Gottfredson and Hirschi’s (1990) *A General Theory of Crime* proposed self-control as a construct that broadly explains virtually all offending. This theory posited that low self-control, a stable individual characteristic, is directly linked to increased offending and analogous behavior (e.g., smoking, drug use, risky sexual behavior, among others; Vazsonyi et al., 2017). Although refined and updated over the years, self-control theory enjoys strong empirical support and is one of the most tested theories of crime (Pratt & Cullen, 2000; Vazsonyi et al., 2017). A reformulation by Hirschi (2004) stated that self-control is a “tendency to consider the full range of potential costs of a particular act” (p. 544). This reformulation brought self-control theory closer to deterrence theory, where the individual’s propensity (self-control) influences the cognitive processes of risk appraisal and calculating consequences.

Studies have found that low self-control is not only related to offending behavior but also long-term patterns of offending over time (Altikriti et al., 2020; Vazsonyi & Huang, 2010). Moreover, self-control has been found to be generally stable (Arneklev et al., 1998; Barnes et al., 2017), although with some exceptions (see Burt et al., 2014; Steinberg et al., 2008), with some researchers asserting an indirect relationship between low self-control and offending (Altikriti, 2021; Nagin & Paternoster, 1993; Piquero & Tibbetts, 1996). A central underpinning of self-control theory is that those with low self-control are more impulsive and less likely to consider

the long-term consequences of behavior (Gottfredson & Hirschi, 1990). Research on self-control and perceptions of offending have generally found that low self-control contributes to criminogenic perceptions of risk and reward, with some reporting perceptions of risk and reward of offending as mediating a substantial portion of the effect of self-control on offending (Altikriti, 2021; Piquero & Tibbetts, 1996).

### **Psychopathy & Psychopathic Personality Traits**

Psychopathy, with its constituent personality traits, overlaps with antisocial personality disorder (ASPD) from the Diagnostic and Statistical Manual of Mental Disorders. The traits underlying psychopathy include callousness, unemotionality, narcissism, and disinhibition, which are associated to detrimental life outcomes and behavioral maladaptation (Vaughn et al., 2008). Beyond detrimental life-course outcomes and maladaptation, psychopathy has also been associated with antisocial behavior (DeLisi, 2009). Moreover, psychopathic personality traits have also been demonstrated to have an association with crime and especially violent offending (Heilbrun, 1979). Although psychopathy is often conceptualized as a single construct, research has also assessed the dimensionality of psychopathy (e.g., dishonest charm, manipulation, thrill-seeking, and impulsivity). Research, however, finds that these subconstructs often factor and can be used in as unitary construct (Lee & Kim, 2020)

Like self-control, psychopathy is purportedly stable over time and has been implicated in longitudinal patterns of offending (Altikriti et al., 2020; McCuish et al., 2014). The mechanisms that link personality traits, such as those encompassed by psychopathy, and offending are unclear. Extant research, however, offers some clues about the potential for perceptions of risk and reward linking psychopathy and offending (Altikriti & Nedelec, 2020). The constituent characteristics encompassed by the construct of psychopathy, such as callous and unemotional traits, remorselessness, and narcissism, have been found to impede conditioning to stimuli (DeLisi, 2009; López et al., 2013). These traits have been shown to be associated with reduced

risk and increased reward appraisal of offending behavior (Altikriti & Nedelec, 2020).

### **Executive Function**

Executive function refers to the brain's coordinated activity that is integral to planning, decision-making, behavior inhibitions (Nigg, 2017). As such, executive function plays a fundamental role in the consideration of long-term consequences of behavior and value-based decision-making such as risk and reward appraisal (Damme et al., 2019). Studies have reported that reduced executive function is related decreased risk appreciation (Botdorf et al., 2017; Brennan & Baskin-Sommers, 2018). These findings are corroborated by results suggesting that lesions in the prefrontal cortex are associated with subsequent deficits in decision-making and appropriate risk/reward appreciation (Bechara et al., 2000).

Although somewhat limited in criminology research, a few studies have examined how executive function affects the consideration of the risks and rewards of offending (Botdorf et al., 2017; Brown et al., 2016). Moreover, executive function also seems to overlap with self-control (Beaver et al., 2007), suggesting that there is an association between the two constructs in influencing perceived risks and rewards of offending. More recent research has assessed the mediating links between executive function self-control on offending (Schwartz et al., 2020), and the effects of the relationship between executive functioning and perceptions of risk reward on offending behavior (Altikriti, 2021; Fino et al., 2014). These studies find that executive function plays a role as an exogenous factor that influences the more proximal predictors of offending.

### **Morality**

Many people report that they obey laws not out of fear of sanction, but out of moral obligation (Piquero et al., 2011). Generally conceptualized as principles of conduct regarding the acceptability of behavior, morality has been shown to be related to perceptions of offending risk and reward (Hirtenlehner et al., 2014). Although some studies have contended that morality may be a trait that influences perceived risk and reward (e.g., Altikriti, 2021), others have argued that

morality is a proximal characteristic that is more closely related to offending decisions (e.g., Piquero & Tibbetts, 1996). In either formulation, morality, it seems, is an integral part of the offending decision-making process. In assessing how morality influences deterrence, Pogarsky (2002) concluded that three distinct groups of individuals varied in their deterrability depending on their levels of morality. Briefly, Pogarsky reported that those with high morality are unlikely to offend no matter the risk or reward. Others with relatively lower morality scores and a lack of regard for risk are more likely to offend given an opportunity. In between these two groups, those with relatively lower morality but appreciation for the risks of offending is influenced by elements of deterrence.

Situational action theory maintains that morality, along with self-control, plays an important role in influencing situational factors of offending, such as perceptions of risk and reward of offending (Pauwels et al., 2018). Further studies have indicated that morality influences risky lifestyle choices (Svensson & Pauwels, 2010; Wikström & Svensson, 2008) and violent responses to provocation (Haar & Wikström, 2010). There is also evidence that morality mediates the effects of peer influence on offending (Walters, 2018). In all, morality exhibits a close association with offending and can condition aspects of deterrence such as risk. These relationships suggest morality is an important concept to include in studies of IDs on perceptions of offending risk and reward.

### **Peers**

Association with delinquent peers has been found to be one of the most salient predictors of offending behavior (Matsueda, 1988; Pratt et al., 2010). Although peer influence is not considered an individual trait, studies have argued that individuals may be predisposed to self-selection into certain peer groups (Gottfredson & Hirschi, 1990; Monahan et al., 2009). Moreover, peer influence has been found to influence both risk taking and antisocial behavior (Gardner & Steinberg, 2005; Monahan et al., 2009) where aspects of social learning theory

overlap with aspects of rational choice and deterrence models (Akers, 1990). Additionally, social costs and rewards are intimately related to peers and associations, where peers can indirectly influence offending through influencing how one views its acceptability (Walters, 2018).

Furthermore, in their assessment of differential deterrence, Piquero et al. (2011) state that an individual's capacity to be deterred is affected by their position within a social network. These positions are influenced by the number of ties and frequency of communication with others. Thus, social networks are a crucial component of the formation of perceptions of risk and reward. Piquero et al. conclude by stating "perceptions of sanction threats may be based... their position within a social network... [where] one's position... an important *individual characteristic* [emphasis added] that would affect how easy or difficult it would be to deter" (pg. 348). Thus, although peer associations are not a stable individual difference, they have been viewed as an individual characteristic that is unique to some within a social network. Further, due to peer influence being a component of many criminological theories either directly or indirectly, ignoring peer influence in criminological studies on IDs and offending perceptions risks misspecification.

### **Emotion**

Although there is no single construct representing emotion, it is conceptualized as neurophysiological responses to stimuli which can affect thinking and behavior (Cabanac, 2002). The broad array of emotions typically include anger, fear, sadness, agitation, among others (Cabanac, 2002). Emotions have long been implicated in criminological theory and even predict long term patterns of crime (Giordano et al., 2007; Mazerolle et al., 2003; Roche et al., 2020). Moreover, emotions have been found to influence cognitive processes related to crime (Giordano et al., 2007; Pickett & Bushway, 2015). Research has indicated that emotions can influence decision-making and risk-taking (Botdorf et al., 2017; Pickett & Bushway, 2015) and influence behavioral inhibition and appetitive stimuli (Merchán-Clavellino et al., 2019).

Research has also indicated that some emotions may be better predictors of situational influences of offending than some of the more notable criminogenic traits such as self-control (Pickett et al., 2018). Some studies have also found that emotions including (e.g., negative affect) play an integral role in the offending process (van Gelder & de Vries, 2014). For example, emotions such as fear, have exhibited potential to mediate perceptions of risk and willingness to offend (Roche et al., 2020). Other studies have found that emotions such as anger can influence perceptions of informal (Carmichael & Piquero, 2004) and formal sanctions (Bouffard, 2015). In all, emotions seem to play a vital role in the interplay between perceptions of offending and offending behavior. The current project uses emotionality as a broad construct, including several underlying concepts (e.g., anger, negative affect, fear).

### **Chapter Conclusion**

Individual traits have played an integral role in criminological theorizing over the years. Theorists have made arguments that stable traits can result in offending stability over time. These theories often point toward distal developmental factors that lead to offending years later and maintain a probabilistic view on offending (Featherman & Lerner, 1985). Often missing from these theories, however, is the proximal link to how individual traits impact offending decisions and behavior. Conversely, situational characteristics of PCC are typically construed as proximal factors that affect offending instantaneously (Paternoster & Simpson, 1993). These two perspectives of offending behavior—IDs and situational characteristics—are often assessed independently. Their merger in some studies, however, has suggested that they may work in concert to affect offending through a processual manner (Altikriti, 2021; Nagin and Paternoster, 1993). Although individual studies have assessed the interlinked relationships between IDs, PCC, and offending, consensus on the influence of IDs of PCC is lacking. Specifically, there have yet to be an empirical assessment to address whether IDs influence PCC and the specific relationships that constitute that relationship. The current chapter provided an overview of

prominent trait theories of offending and their potential link with PCC. The upcoming chapter discusses a methodology—meta-analysis—that can be used to furnish evidence of a consensus within the literature. Meta-analyses assess on an aggregate level whether individual studies and the constituent estimates suggest evidence of an association.



## Chapter 3: Meta-Analysis

### Goals of a Meta-Analysis

Meta-analysis is a method used to quantitatively synthesize extant research on a topic. With various individual research studies on a single topic, overarching themes and conclusions can be difficult to detect. Furthermore, heterogeneity in results across independent studies is difficult to capture, let alone quantify. A meta-analysis aggregates individual studies addressing similar research questions to find general themes in a topic area while also extrapolating nuances of methodology that may affect the results (Borenstein et al., 2009; Greenland & O'Rourke, 2008). Put in the most basic terms, a meta-analysis “refers to the analysis of analyses” (Glass, 1976, p. 3). Given these parameters, a body of literature must be sufficiently large and encompass sufficient methodological variation to justify a meta-analysis. The previous chapter reviewed the current research on IDs and PCC. The growth of recent research on the topic, along with the wide range of IDs, specific aspects of PCC, samples, and varying analyses have created a need for a meta-analysis to summarize the prior literature and to orient future research on the topic.

There are numerous reasons and benefits of conducting a meta-analysis. Deriving a pooled overall estimate summarizing the literature with less error relative to any individual study is perhaps the most directly applicable and informative outcome of a meta-analysis. The derived estimate is often a weighted average comprised of multiple individual estimates. The overall estimate specifies a statistical overview representing the variation in the underlying estimates that constitute it—i.e., individual studies (Borenstein et al., 2009; Rosenthal & DiMatteo, 2001). Often, this estimate serves as a quantitative snapshot of the literature, with several advantages and disadvantages. In the current project, this snapshot summarizes what previous literature has suggested about the relationship between IDs and PCC. Specifically, in deriving a less subjective measure of the underlying studies, the current project produces an empirical estimate that

represents the overall state of the literature on the association between IDs and PCC.

## **Advantages**

### **Reduced Subjectivity**

Traditionally, the field of criminology, and the social sciences more broadly, have relied on literature reviews to summarize the literature on a given topic (Pratt et al., 2010; Rosenthal & DiMatteo, 2001). Systematic and narrative reviews follow a procedure of collecting and qualitatively synthesizing studies relevant to a particular research question. These reviews can reveal important findings and patterns, and even spur new research. The downside, however, is that these reviews are often selective and typically provide broad conclusions regarding the research (Pratt et al., 2010). Narrative reviews can be biased due to the collection of literature and the synthesis thereof can be subjective as it relies on the author's judgment regarding the inclusion and exclusion of studies and the overall synthesis processes (Rosenthal & DiMatteo, 2001). Further, although systematic reviews often provide broad summarizations of the research in qualitative terms, these conclusions typically come in the form of rough summaries that may lack important nuances (Rosenthal & DiMatteo, 2001). Moreover, these reviews can become more problematic as the body of literature increases in size, straining the ability of any investigator to adequately retain and summarize the enormous amount of information.

These drawbacks of systematic and narrative reviews are generally considered strengths of the meta-analysis procedure. First, meta-analyses reduce the capacity for investigator bias through the use of statistical analyses to assess the underlying studies. Second, systematic and detailed procedures ensure that a meta-analysis can be replicable, unlike a narrative review which is based on the interpretation of the investigator. Third, all else equal, meta-analyses are more accurate and comprehensive when larger bodies of studies are included, leading to more precise estimates (Pratt et al., 2010; Rosenthal & DiMatteo, 2001). Finally, a meta-analysis provides a concise summarization of the literature by yielding specific point estimates with

accompanying variances to represent the general pattern of results across the study sample (Rosenthal & DiMatteo, 2001). Beyond addressing some of the pitfalls of a narrative review, there are two other methodological motives for using a meta-analysis to address the research question in the current project: establishing a basepoint estimate and exploring different patterns of results.

### **Establishing a basepoint estimate**

One of the key reasons for undertaking a meta-analysis is to establish an estimate with which to summarize the literature. The current project is no different in that respect. In the current project, the main motive is to establish an initial point with which to judge how IDs affect PCC. Here, the current project intends to summarize and establish a key point estimate on the general effect of IDs on PCC across studies that have estimated such a relationship. In doing so, the current project aggregates the relevant literature to produce more statistical power and establish a more confident estimate than achieved from any individual study. Ultimately, this provides a statistical representation of the underlying studies that is less affected by the stochastic nature of individual studies (Lipsey & Wilson, 2001; Rosenthal & DiMatteo, 2001).

### **Exploring patterns of findings**

Another main contribution of undertaking a meta-analysis is to uncover patterns of results that are due to methodological variations across studies (Rosenthal & DiMatteo, 2001). Studies on the same topic can employ vastly diverse methodological characteristics which may affect the results and the subsequent conclusions. A meta-analysis is able to compare results across studies that have employed various methodological differences. Beyond identifying patterns of methodological variation associated with the results, this process can aid in reconciling contrasting findings across studies and quantifying these differences. Varying methodological protocols across studies are often included as moderators in the meta-analysis process (e.g., sample differences, the use of control variables, and the operationalization of variables). For

example, studies of IDs and PCC have often used differing samples including adolescents (Hirtenlehner et al., 2014; Schepers & Reinecke, 2018), general populations (Bouffard, 2015; Neissl et al., 2019), and offending populations (Altikriti & Nedelec, 2020; Piquero et al., 2016). The variation inherent in different samples—among other methodological variations—produces difference across the studies that is important to contextualizing the potential association, and accompanying variability, between IDs and PCC.

### **Disadvantages**

Although meta-analyses offer many advantages and benefits relative to any single study, there are certainly some criticisms of the technique. These criticisms, however, are not fatal to the meta-analytic process as they can be mitigated. Several statistical and methodological adjustments can be used to increase confidence in the results (e.g., funnel plots, fail-safe  $n$ , and  $p$ -curve analysis). Despite limitations, the use of meta-analyses to organize bodies of research has increased in popularity, demonstrating the benefits of the methodology (Borenstein et al., 2009). Some of these limitations are discussed below along with potential methods to mitigate their effects.

#### **One number cannot summarize a research field**

A criticism of meta-analyses is that the derived estimate intended to summarize the literature may be a shortsighted endeavor. Critics (e.g., Bailar, 1997) argue that bodies of research are often varied in methodology and likely consists of a heterogeneous pool of complex and conflicting findings. In other words, one estimate does not contain enough information to adequately summarize a complex body of research. Although a valid criticism, this is a narrow view on meta-analyses. If an investigator subjects a broad body of research to a meta-analysis, the resulting estimate and heterogeneity in the underlying results will fall along a spectrum from consistent to highly disperse. If the results are consistent, then the investigator can yield a point estimate summarizing the literature with narrow confidence intervals. However, if the point

estimate is derived from studies with varying findings, then the derived confidence intervals around the estimates widen. The investigator, therefore, can focus on the source of the heterogeneity across studies (e.g., study design, sample differences, variables included in the analyses). This finding of heterogeneity can be a strength of meta-analyses, where the method can be used to ascertain the source of conflicting findings and heterogeneity in results across studies. For example, certain samples or control variables yielding divergent results. Thus, meta-analyses can detect patterns of heterogeneity and provide a way forward for future studies to undertake more precise methods considering the findings.

### **The file drawer problem**

Another criticism of meta-analyses is based on publication bias favoring statistically significant results. Typically, meta-analyses primarily comprise published studies (see Egger et al., 1997; Rosenthal, 1979). Because studies that yield results which are not statistically significant are less likely to be published (Easterbrook et al., 1991), the resulting pool of published research is biased in that it is more likely to include studies that achieve significant results, regardless of what the true relationship may be (Borenstein et al., 2009). Thus, publication bias causes a research area to consist of a higher proportion of studies with significant results than is truly warranted, potentially inflating the findings, and resulting in what is referred to as the file drawer problem—a reference to unpublished manuscripts housed in the obscurity of file drawers.

In taking the file drawer problem to its most extreme and unlikely scenario, Rosenthal (1979), implied that all published works in journals which find statistically significant findings could comprise the 5% of studies that were a result of Type I errors. The file drawer problem is especially acute when it comes to studies with smaller samples, which reduces statistical power, resulting in more non-significant findings. Ultimately, the file drawer problem inflates individual effect sizes and restricts the range of estimates to include more published studies (relative to

conducted studies), resulting in inflated estimates with an artificially restricted range of variability (Cooper et al., 1997; Olson et al., 2002). Although the file drawer problem presents concerns for meta-analyses and the academic research enterprise as a whole, there are solutions available to mitigate these concerns.

### **Potential solutions to publication bias**

#### ***Funnel plot***

One way to inspect for potential influence of publication bias is to create a scatter plot of the individual effect sizes and their corresponding sample size. This creates an inverted funnel where larger samples, likely to produce smaller standard errors and situated higher on the y-axis, are more likely to yield less diverse estimates relative to smaller studies which should have more variation in the estimates and therefore a wider range of estimates (Duval & Tweedie, 2000). This resembles an inverted funnel with effect sizes plotted against the standard errors (Sterne et al., 2008). A symmetrical funnel plot points to limited publication bias because studies with smaller samples are not skewed to one side, suggesting no substantive relationship between sample size (or standard error) and effect size (Light & Pillemer, 1984). In contrast, asymmetry in the funnel plot suggests publication bias (Duval & Tweedie, 2000). The asymmetrical pattern is a function of small sample bias, where larger samples are more reliable, and thus, more likely to represent the true relationship. Thus, a relationship between standard errors and effect sizes implies that smaller studies with effect sizes outside the norm are more likely to be published (Light & Pillemer, 1984). However, due to the visual nature of examining the funnel plots, conclusions derived from such inspections are not definitive, but provide a general overview of potential concerns.

#### ***Egger's test of the intercept***

Egger's test of the intercept (Egger et al., 1997) is an estimate that quantifies the asymmetry in the funnel plot and conducts a statistical test, providing a snapshot of how study

size can influence results (Begg & Mazumdar, 1994). This approach applies a statistical evaluation of the funnel plot mentioned above. Specifically, this procedure regresses the effect sizes on their standard errors, which is influenced by the sample size. Finding a statistical association between the standard errors and the estimates can represent evidence of publication bias and asymmetry in the funnel plot. Although a non-significant correlation may suggest the absence of bias, that conclusion is not definitive. Alternative explanations, such as low statistical power, could be the source of a non-significant correlation (Begg & Mazumdar, 1994; Sterne et al., 2000). However, deriving a statistically nonsignificant result from the Egger's test lends support for the absence of publication bias.

#### ***Fail-safe number***

Yet another procedure for addressing the file drawer problem is to conduct a fail-safe file drawer (FSFD) analysis (Rosenthal, 1979). The central idea here is to estimate the hypothetical number of unpublished null results that would compromise the conclusion of a meta-analysis by bringing the results of the review to non-significance ( $p = .05$ ). Specifically, Rosenthal's (1979) method uses the estimate derived from the meta-analysis, taking into account the number of constituent estimates and contrasts that with the hypothetical number of studies with an assumed mean effect size of zero. From this calculation, if a relatively small number of studies with an assumed effect size of zero nullify the statistical significance of the estimate derived from the meta-analysis, then the conclusion of a meta-analysis could be compromised due to the file drawer problem. However, if a large number of studies with an assumed effect size of zero is needed to nullify the results, then this scenario supports the conclusion derived from the meta-analysis (Rosenthal, 1979).

Although there are no standardized guidelines to the FSFD results, the method proposed by Rosenthal (1979) provides an estimate for how tolerant a researcher can be regarding publication bias influencing their conclusions. More recent research has improved this process

by allowing for the calculation of a confidence interval around the fail-safe number. Specifically, the confidence interval is derived by calculating the probability distribution function of the fail-safe number and the distributional assumptions for the standard normal variates in calculating the confidence intervals (Fragkos et al., 2014). Critics of the FSFD, however, contend that the assumption of an effect sizes of zero for unpublished studies may be distorted. Specifically, unpublished studies may contain effect sizes that are counter to the estimate derived from the meta-analysis. In such cases, the fail-safe number would underestimate the true number of studies needed to contravene the conclusions of a meta-analysis.

### ***P-curve Analysis***

The final assessment of bias conducted in the current project is the *p*-curve Analysis (Simonsohn et al., 2014). Unlike the previous assessments of bias which assess the file-drawer problem, *p*-curve analysis addresses a different concern: *p*-hacking. Estimates suggest that *p*-hacking—the search toward significant findings through data analysis—has become a frequent issue in science (Head et al., 2015). *P*-curve analysis assesses the distribution of significant *p*-values. Under a null assumption, a uniform distribution of *p*-values (e.g., 20% at .5, 20% at .04, 20% at .03, 20% at .02 and 20% at .01) is expected. However, if there is an uneven distribution with more values that are marginally significant (e.g., .05) relative to smaller *p*-values (e.g., .01), then *p*-hacking may be a concern. This is due to the underlying logic that *p*-hacking is a process with which data analyses are incrementally tweaked to produce marginally significant findings (Head et al., 2015). If there is a true effect, then s distribution of *p*-values is likely exhibit significant right-skewed toward larger *p*-value. A right-skewness test assesses whether the *p*-curve derived from the distribution of significant *p*-values is significantly right-skewed, which suggests that there is a “true” effect rather than *p*-hacking or a null effect (Head et al., 2015). Another test, the Flatness test, analyzes if the *p*-curve is flat, which suggests that either power is insufficient or that there is no effect. These supplementary analyses will be used as diagnostic



tools to assess the robustness of the findings derived from the meta-analyses.

### **The Process of Meta-Analysis**

Although the file drawer problem and bias present serious challenges for meta-analyses, and each method employed here has its shortcomings, when employed in tandem, these procedures can increase the confidence in the conclusions of a meta-analysis (Ferguson & Brannick, 2012). Ultimately, meta-analyses are still one of the best solutions available to empirically summarize a body of research (Pratt et al., 2010). Using pooled estimates from individual studies to produce a weighted average representing the state of the literature provides a concise and informative summary regarding a research question (Borenstein et al., 2009; Rosenthal & DiMatteo, 2001). Further analyses can provide a nuanced portrayal of the variation in the results observed across the individual studies at hand. Prior to estimating the meta-analytic results, a systematic process should be followed in searching, collating, and coding the literature (see Stanley, 2001). This process involves several interlinked stages, each reviewed below.

#### **First stage**

The first stage, as with most research projects, begins with a formulation of a testable research question. The research question should be broad enough to meaningfully contribute to the literature on a given topic but narrow enough to be addressed with a few *a priori* stated hypotheses. Further, the research question should include aspects of the variables included and the population under investigation (Aslam & Emmanuel, 2010). In a similar fashion, meta-analyses begin with a research question revolving around summarizing the state of the research in a certain area. In the current project, the main research questions are: (1) are IDs associated with PCC; (2) which specific IDs are salient correlates of PCC; and (3) how do study characteristics influence the observed relationships observed in between IDs and PCC. A meta-analysis is perhaps the most apt methodology available at answering these questions once a sufficiently large base of empirical studies has been generated. The literature on the association

between IDs and PCC now appears sufficiently large to warrant a synthesis through meta-analysis.

### **Second stage**

The second stage entails a search of the literature. Meta-analyses use the collected literature as the sample for analysis, and, therefore, it is crucial that the literature sample used is comprehensive and thorough to mitigate concerns about generalizability and representativeness. To draw valid conclusions from a meta-analysis to the research body, the data used should be as unbiased as possible. Although related, this is not the same concern that affects meta-analyses through publication bias. A comprehensive and thorough search of the literature does not mitigate publication bias as the body of literature itself is already affected by publication bias. Conversely, a meta-analysis of a body of research not affected by publication bias can yield biased estimates if the sample of studies selected is not representative of the full body of research. To ensure the sample collected for meta-analysis is as unbiased as possible, a thorough search of the literature capturing as many studies as possible is required.

### **Third stage**

The third stage in conducting a meta-analysis entails the selection of studies based on inclusion criteria. This stage follows up on the previous step by organizing and filtering the studies selected in the search process. Where the second stage attempted to capture as many studies as possible that are related to the research question at hand (i.e., the first stage), the third stage attempts to limit the captured studies to only those that meet predesignated criteria for subsequent analysis. Some of the most frequent criteria for inclusion in a meta-analysis include (but are not limited to): empirical results, analysis type (e.g., randomized trials, correlational studies, difference in means tests), dependent and independent variables corresponding with the research question(s), and study quality (e.g., determining the quality studies and exclusion criteria). Crucial to this step and its aim to minimize subjectivity is to define and explicitly state

the selection criteria and to apply the criteria to all studies to ward off investigator bias. These measures are discussed in more detail regarding the current project in Chapter 4.

#### **Fourth stage**

The fourth stage is coding the studies selected for analysis. Because meta-analysis is a technique that relies on the analysis of data to yield empirical estimates, a data set must be created for subsequent analysis. Although studies can be included as separate data points (i.e., each study provides one estimate), depending on the investigator's goals, different units of analysis can be of focal interest (e.g., estimates as the unit of analysis). These can range from research teams to the individual estimates within a study, each with various benefits and drawbacks (see Cooper, 2015, for a review).

Research teams as the unit of analysis is considered the most conservative method of yielding meta-analysis results (Cooper, 2015). The logic behind treating a research group or team as the unit of analysis is that multiple results derived from the research of a specific group may be biased or not independent. Including various studies from a wider net of contributors and limiting contributions from the same research team partially allays this concern. This process entails collating all the research done by their respective research teams and deriving an overall conclusion for each particular research group—a kind of meta-analyses within meta-analysis. A drawback of such a technique, however, is that there will be fewer estimates to use in the final meta-analysis and reduced nuance between studies as variation across research studies within groups is ignored. An alternative measure that alleviates these drawbacks but still accounts for the potential of non-independence within a research team is to include a measure in the meta-analysis for research teams that can be assessed for its effect on the estimates derived in the meta-analysis—a moderating variable. For these reasons, using research teams as a unit of analysis is rarely done in meta-analyses (Cooper, 2015).

Using individual studies as a unit of analysis is another method to deriving results from a

meta-analysis. Here, individual studies, including those with multiple estimates, are each included as one case, ensuring that each study contributes equally to the overall meta-analysis results. This is typically done by culminating the estimates derived from the results in one overall estimate for each study. Although there are some benefits to this method, such as mitigating concerns about the independence of estimates derived from the same studies, a drawback is that there are fewer estimates used and there is data loss due to the estimates that were merged within studies. Moreover, studies occasionally use multiple samples to address their research questions (e.g., male and female samples). The use of multiple samples, even for the same analysis, yields different results. Therefore, each estimate derived from different samples will contribute a unique estimate of the relationship of interest. As with research groups, if estimates within studies are used as the unit of analysis, studies can be included in the analysis as a grouping variable to account for differences across studies (Cooper, 2015).

#### **Fifth stage**

Finally, in the fifth stage, a meta-analysis can be composed of data on each estimate derived from each study that meets the inclusion criteria. In this case, the combination of multiple analyses or multiple samples from the same study may yield several estimates. Here, each estimate is treated as an individual unit. This procedure maximizes the number of available estimates for analysis and avoids losing any of the within-study characteristics that moderate the estimates. A drawback of this procedure, however, is that certain studies may contribute unequally toward the overall meta-analysis estimate. In other words, studies with more samples and multiple analyses are weighted more heavily in the overall estimate regarding the research question.

As with any type of research, it is up to the investigator to be judicious in choosing the most suitable method of analysis. The current project used each estimate as the unit of analysis for two reasons. First, deterrence research has previously yielded conflicting findings with

studies concluding that deterrence either reduces offending (Loughran et al., 2012), increases offending (Pogarsky & Piquero, 2003), or produces mixed effects (e.g., Pogarsky, 2002). Because of the seemingly large heterogeneity in results regarding deterrence, using studies or research teams as the unit of analysis (e.g., averaging) would restrict the capacity of the meta-analysis to yield estimates for moderating factors affecting the results. The data loss from using aggregated units of analysis would mask important methodological variation that helps to understand the nuanced nature of deterrence on complex behavior (i.e., offending). Second, choosing one estimate from studies or research teams may seem arbitrary and lead to researcher bias as there is no objective way to delineate which estimate is superior to the other (Pratt & Cullen, 2000; Pratt et al., 2010). In addressing the pitfalls of using individual estimates as the unit of analysis (i.e., disproportionate influence on the overall estimate from studies with multiple estimates), the current project uses multilevel modeling. Thus, estimates are nested within studies to account for the effects that studies may have on the overall effect and statistical non-independence (see Gleser and Olkin, 2009; Raudenbush & Bryk, 2002).

### **Chapter Conclusion**

Meta-analyses can have several goals, but the main objective is to summarize a specific body of research in response to a research question. Modern statistical advances have made it possible to summarize a body of literature not only by averaging the estimates across studies, but strategically weighting those estimates in correspondence with other details. Furthermore, meta-analyses permit the investigator to go beyond summarizing the literature and into assessing various methodological variations that may affect the results. These factors allow the investigator not only to assess whether the research literature suggests an overall pattern, but also whether the pattern holds across various samples, operationalization of variables, study designs, and other factors, providing a more nuanced portrayal of a research area. Regarding the current project, a meta-analysis present an inclusive method to 1) deriving an overall estimate of the relationship

between IDs and PCC, 2) deriving more granular estimates of specific IDs and their associations with specific PCC, and 3) assessing how methodological variation can influence the results of previous research. These benefits have made the technique of meta-analysis the prevailing method for summarizing a research area (Pratt et al., 2010). Ultimately, whereas research is conducted on a study-by-study basis, a meta-analytic approach emphasizes the aggregation of these studies to come to a conclusion on the state of the literature on a topic.

## **Chapter 4: The Methods**

The current project collated and reviewed estimates on the effects of IDs on PCC, and meta-analyzed their results. Therefore, the main goal of the current project was to empirically summarize current knowledge regarding the association of IDs and PCC. Four primary aims were embedded in the current project. The first was to generate a pooled estimate to summarize the association of IDs and PCC. The second was to generate constituent effect sizes for the various IDs (i.e., self-control, IQ/executive function, psychopathy, peer influence, emotionality, and morality) and their association with PCC. The third was to contextualize these effect sizes across methodological differences in the included studies. The final goal was to use the results to guide future research and elaborate on the gaps exhibited in the literature.

### **The Search Process**

The most pivotal part of any study is the internal validity of the methods, data, and the inferences derived from them, because without internal validity, there are no meaningful results to generalize. When it comes to meta-analyses, the data acquired through the literature search process is the lynchpin of having a representative outcome of the literature. Specifically, systematically searching and organizing the literature strengthens the integrity of the study and its findings. Following best practices (Cooper, 2015), the current project searched and compiled relative literature through two stages: primary and secondary searches. The primary stage proceeded by conducting a methodical search for abstracts that contain relative keywords published before October 2020. Subsequently, the results were parsed for inclusion/exclusion based on their title or abstract containing the requisite characteristics of (1) including an empirical assessment between at least (2) one perception of risk or reward variable and (3) one individual differences variable. Studies that met these three criteria were then assessed more thoroughly to ensure at least one empirical estimate between a perception of risk or reward

variable and an individual differences variable. Following this initial search, the second stage involved gleaning additional studies of relevance from the collected literature. This step included parsing through the cited works and references in the studies from the primary search. The literature search process took place in two databases, EBSCOhost (including Academic Search Complete, Academic Search Premier, Criminal Justice Abstracts with Full Text) and PsycINFO. These databases were chosen due to their inclusivity and breadth of published and unpublished research, including periodicals, reports, books, and journals.

### The Keywords

In searching the body of literature for relevant studies, the current project employed a Boolean search process with modifiers to produce more relevant results than a simple search. The Boolean search used a combination of AND modifiers within three broad categories and OR modifiers within them (see Table 1 for more details).

Table 1. Search terms and Boolean operators used in searching the literature.

		<b>Categories</b>		
		Rational Choice/Deterrence	Individual Difference	Crime/Offending
<b>Search terms</b>	Certainty N2 punishment		self-control	offend*
	Deterrability		impuls*	crim*
	Deterability		psychop*	arrest*
	deterrence		individual difference	apprehen*
	perceived punishment		peer	conviction
	sanction risk		friend	
	perce* N3 risk		personality	
	rational choice		intelligence	
	social costs		IQ	
	reward		cognitive ability	
			executive func*	
			emotion*	
		moral*		

*Note.* AND operators were used across categories; OR operators were used between search terms; N2 and N3 are used to link terms with a proximity criterion (e.g., separated by two words).



In searching the relevant literature, two opposing elements are emphasized: coverage and precision (White, 1994). Coverage refers to the representativeness of the sample of literature to the entire body of research on the topic. Precision refers to the degree of congruence between the intended sample and the obtained sample. The search process used in the current project was intended to identify literature by maximizing the variety of search terms (coverage) while also constraining the search process to identify the most relevant (precision) studies (Cooper, 2015). This process is exemplified through using the three categories and their constituent search terms in Table 1. Although the concepts of coverage and precision are typically considered opposing, using advanced search procedures, including multiple categories and a variety of constituent terms, aids in increasing coverage and precision.

Toward the goal of maximizing coverage and precision, three broad categories representing IDs, perceptual deterrence, and offending were used. Specific terms within each category were used to maximize coverage (see Table 1). Two operators were then used to manage how the search terms were employed. Between categories, an *AND* operator was used to ensure that at least one term from each category (IDs, PCC, and offending) was present in either the title or abstract of the study. Then, *OR* operators were used between each of the search terms so that any combination of at least one term was present in the identified study. Further, asterisks were used to identify terms with multiple variations in conjugation. Lastly, between terms that are interrelated, and may not accurately represent the intended search term if separated (e.g., certainty of punishment) *N* operators were used to ensure that these terms were within reasonable proximity of each other (e.g., certainty *N*2 punishment to ensure that “certainty” was no more than two words separated from “punishment”). Uncovering the literature for a meta-analysis can be a daunting task. Using the advanced search features described casts a wider but more precise net to capture relevant studies for potential inclusion in the current project (Cooper, 2015).

The particular categories of terms used were intended to ensure that identified studies

included the following three themes: 1) a rational choice/deterrence perspective; 2) an aspect of IDs; and 3) some relevance to offending or formal sanction. Including only two categories would cast a wider than intended net, capturing studies with no relevance to the current project. For example, if the third category is omitted, then the first two categories would capture studies that are unrelated to offending or formal sanction (e.g., general risk-taking studies).

### **The Filtering Process**

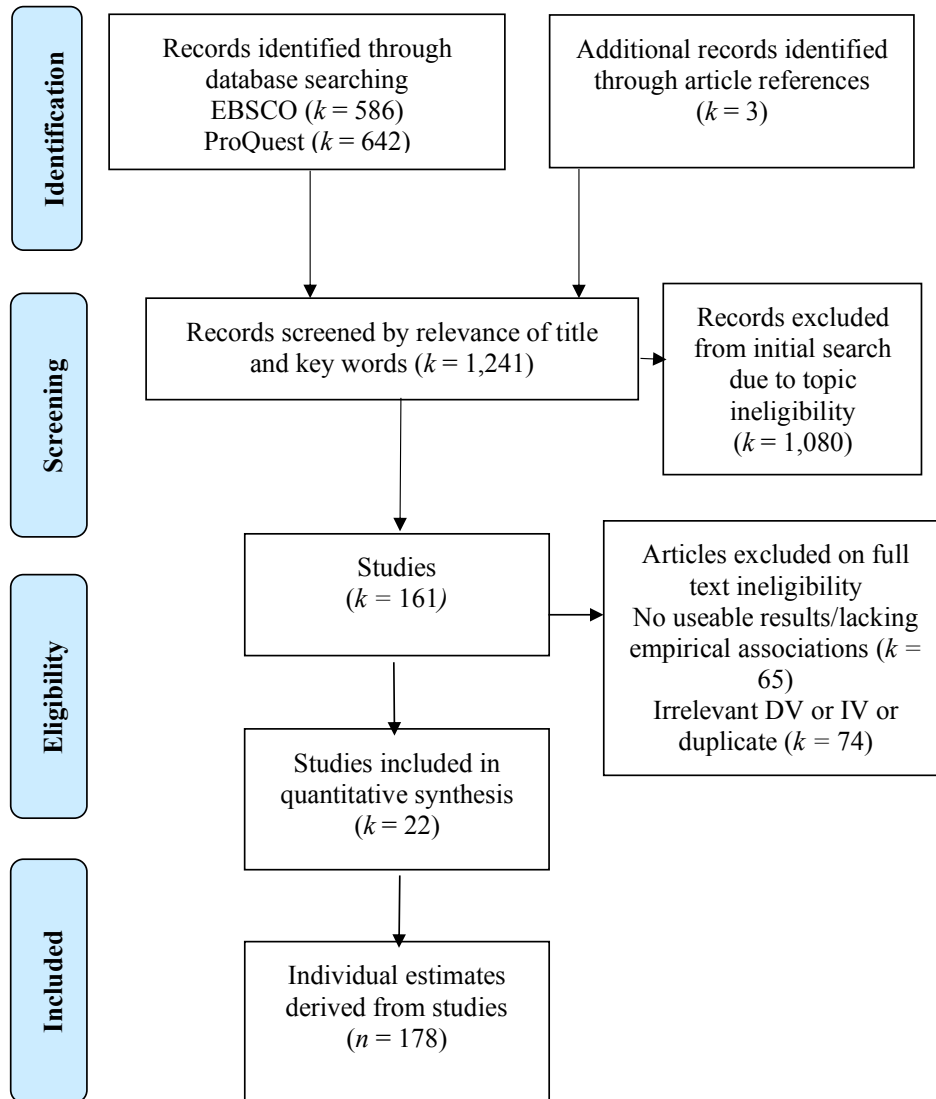
The filtering process was conducted in four stages depicted in Figure 2. Initially, the literature search identified  $k = 586$  studies in the EBSCOhost search,  $k = 642$  in Psych INFO (including duplicates not flagged by the databases and duplicates across databases), and  $k = 3$  through searching article references. In the second filtration stage, the relevance of the final sample of identified studies across both databases ( $k = 1,241$ ) was systematically reviewed, using the titles and abstracts, for relevance to the current project. In this step, studies with a focus on an unrelated theme were excluded, resulting in a total of  $k = 161$  studies. Common unrelated themes included non-empirical (e.g., strictly theoretical), victimization, medical, macro-level, law-oriented, attitudes/perceptions about crime/safety, risk assessment, policing, rehabilitation, terrorism topics. In the third stage of the filtration process, the remaining identified studies were included if they (1) were not duplicates and (2) included empirical analyses (bivariate, multivariable effect sizes) for at least one relevant independent variable of interest (IDs variable) and one dependent variable of interest (PCC). This process resulted in 22 studies that empirically provided an estimate of a relationship between any of the aforementioned IDs. In the final stage, the remaining studies were further divided into their constituent results regarding the outcomes of interest (i.e., individual estimates). Specifically, the current project used the separate empirical estimates related to a unique independent variable and dependent of interest as the unit of analyses. This process resulted in some studies contributing multiple estimates derived from

unique relationships across variables and/or samples.<sup>1</sup> Thus, the resulting analytical sample included  $k = 22$  studies, from which  $n = 178$  estimates were derived.

---

<sup>1</sup> Although using multiple estimates from the same study poses potential concerns for statistical independence (Pratt et al., 2010), this is accounted for through the use of a multi-level analysis design (see the Analysis Process subsection).

Figure 2. Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram.



## **The Coding Process**

Once the analytic sample was compiled, relevant data were extracted according to six common themes of variation. These specific themes were chosen for two reasons. First, these aspects of studies were commonly seen as variable across studies, lending themselves to analysis. Second, according to previous literature, these themes (e.g., sample frame, analysis type, control variables) have been shown to influence results of analyses. These six themes include the estimates, study design, sample composition, analyses, dependent variables of interest, and independent variables of interest. The coding decisions were made in light of the data constraints. Coding elements and their procedures are outlined below.

### **Estimates**

To code estimates in a uniform direction, all derived  $r$  coefficients and beta estimates were recoded to be positive if the independent variable (ID) and dependent variable (PCC) theoretically corresponded with increased offending (e.g., increased peer delinquency and increased reward expectation) and negative if there was a disjunction between expected direction and theory (e.g., higher self-control was associated with reduced perceptions of risk or low self-control was associated with increased perceptions of risk). In other words, if both the IDs and PCC factors theoretically corresponded in the same direction with offending, then the estimate was coded as positive, otherwise if either the IDs or the PCC were associated with offending in the opposite direction of theoretical expectation, then they were coded as negative.

Therefore, the positive estimates suggested relationships in the expected direction, while negative relationships suggested that the ID corresponded with the PCC factor in a theoretically unexpected direction. Subsequently, all the derived estimates were transformed from the original estimates using Fisher's  $r$  to  $z$  transformation as the sampling distribution of  $z(r)$  scores is assumed to approach normality, unlike  $r$ , which is skewed for all values larger than 0 (Blalock, 1972). Specifically, all derived estimates (bivariate or standardized regression coefficients) were

converted to a  $z(r)$  score using the following equation (Lipsey & Wilson, 2001):

$$z(r) = (.5) \ln\left(\frac{1+r}{1-r}\right)$$

The transformed scores,  $z(r)$ , are interpreted almost identically to  $r$  from 0 until the upper ranges where they begin to diverge (e.g.,  $z(r) = 0 = r = 0$ ;  $z(r) = .25 = r = 0.26$ ;  $z(r) = .50 = r = .55$ ;  $z(r) = .60 = r = .69$ ;  $z(r) = .75 = r = .97$ ). The variance of  $z(r)$  was then calculated using the following equation (Gorsuch & Lehmann, 2011):

$$s_z = \frac{1}{\sqrt{N-3}}$$

Further, each study was given a unique study identifier as several studies contributed more than one estimate of interest. These estimates were also given a unique identifier (e.g., study 1, estimate 1; study 1, estimate 2). This process was used to nest estimates within studies in the multi-level modeling framework.

### **Study design**

Two characteristics were coded for study design. These characteristics were used as moderators to assess how their inclusion affected the derived estimates. The first is whether the derived estimate controlled for experiential effects (i.e., was prior offending or risk controlled for), with 0 = *no* and 1 = *yes*. Controlling for experiential effects has been shown to be an important aspect of estimating the effects of variables on perceptual deterrence (Hirtenlehner & Wikström, 2017). The second study characteristics was whether the estimate was *cross-sectional* (= 0) or *longitudinal* (= 1), as previous meta-analyses have suggested this may influence results (Pratt et al., 2006).

### **Sample composition**

For each estimate, the sample characteristics were coded across two categories. First, sampling design was coded by the age range, derived from the sample frame, across three categories of *adolescent youths* (= 0), *college students* (= 1), and *general population* (= 2), with

adolescents being the reference category in the moderation analyses. These age categories were chosen as they are the most prominent among the study samples and represent an increase mean age from adolescents (i.e., under 18 years old, to college students, to full population samples). Sample frames are important features of studies and can influence results across samples. The second category was whether a *general* sample (= 0) or *offending* sample was used (i.e., those who have been formally sanctioned = 1). This theme was coded as aspects of deterrence may be influenced by whether individuals have been formally sanctioned before (i.e., experience specific deterrence).

### **Analyses**

The collected studies all relied on observational data (i.e., there were no experimental designs). Therefore, each estimate was coded as either 0 = *bivariate* or 1 = *multivariable*. This coding scheme was used to separate the effects to assess whether including control variables affected the derived estimates. This separation allows the results to approximate the effects of confounding.

### **Dependent variables**

The dependent variable used to derive the estimate was coded along a nominal scale each representing one dimension of perceptual deterrence. This measure ranged from 0 = *perceptions of risk*, 1 = *perceptions of social costs*, and 2 = *perceptions of rewards*. This measure was used to conduct moderation analyses in the initial pooled estimate (with rewards as the reference category) and to filter the dataset into three dimensions for subgroup analyses within each perceptual deterrence factor. Perceptions of risk was derived from estimates that measured any element of formal sanction risk. These measures included some assessment of the likelihood of arrest (e.g., certainty to be arrested) subsequent to offending. Perceptions of social costs were derived from questions that gauged the perceived adverse informal reactions by others (e.g., disapproval or loss of respect from family members or friends) in response to offending. Finally,

perceptions of rewards were derived from measures that assessed the extent of rewards (e.g., thrill, monetary, reputational) expected as a result of offending.

### **Independent variables**

The independent variable used to derive the estimate was coded uniquely for each estimate derived from a unique independent variable of interest (i.e., self-control, IQ/executive function, psychopathy, peer influence, gender, emotionality, and morality). These variables were used to differentiate the IDs and conduct subgroup analyses to derive estimates for each individual difference.

### **Analytic plan**

The meta-analysis in the current project will proceed in a series of interlinked steps. First, descriptive statistics will be presented to summarize the distribution of the analytic sample (estimates) across the independent (IDs) and dependent variables (PCC). Second, assessments of heterogeneity between estimates will be conducted to evaluate the need for random effects models. If significant heterogeneity is present, the current project will use random-effects models to estimate the effects (Schwarzer et al., 2015). If there is no evidence of significant heterogeneity across estimates, fixed-effects models will be generated (see Cooper, 2015). To assess heterogeneity, three measures will be used. The first is Cochran's  $Q$ , which measures the difference between the fixed-effect model and the observed effect sizes. This measure, however, is sensitive to the number of studies and the sample sizes within those studies (Harrer et al., 2019). Therefore, a second measure, Higgins & Thompson's  $I^2$ , which adjusts for the number of studies, is used to estimate the percentage of variability in the effect sizes not due by sampling error. Although this measure is not sensitive to the number of studies included, it is still sensitive to sample sizes within studies. Therefore, a final measure of heterogeneity, Tau-squared ( $\tau^2$ ), is used to estimate the between-study variance in the meta-analysis. A significant Cochran's  $Q$  estimate suggests that there is a difference in estimates when a fixed effect model is conducted.



As a rule of thumb  $I^2 > 50\%$  suggests moderate heterogeneity while  $I^2 > 75\%$  suggests substantial heterogeneity (Higgins et al., 2003). Finally, if  $\tau^2 = 0$  (or confidence intervals overlap with 0), then the random-effects and fixed-effects models would provide substantively similar results (Borenstein et al., 2009). Based on the assessment of heterogeneity, corresponding models that adequately address heterogeneity concerns will be used to derive an overall estimate as a snapshot of the collated literature and, later, the subgroup analyses. Third, a moderation analysis will be conducted to estimate the influence of different PCC factors (risk, social costs, and rewards) as the dependent variable on the pooled estimate. If significant differences across the dependent variables of perceptual deterrence is evident, then each factor will be further assessed in a dedicated subsection. The current project uses multilevel modeling (estimates within studies) whenever appropriate.

With evidence of significant differences in estimates associated with each factor of PCC, the subsequent subsections will be organized by (1) dependent variable (risk, social costs, and rewards) then by (2a) pooled estimates for the bivariate and the multivariable estimates. Subsequent subgroup analyses (2b) will be conducted within each dependent variable. A random effects subgroup analysis is conducted separately from the bivariate and multivariable estimates to furnish estimates for each contributing independent variable and assess for attenuation across study design (i.e., bivariate and multivariable). Consequent to the subgroup analyses, two separate moderation analyses (2c) are conducted to assess the effects of sample characteristics (whether offending and age) and study design (cross-sectional or longitudinal and whether experiential effects were controlled for) on the overall pooled estimate. Finally, tests of bias (2d) are performed on the estimates to assess any potential concerns regarding the robustness of the results (e.g., publication bias). These tests include a visual inspection of the funnel plot of estimates to standard errors, quantifying the association between the estimates and the standard errors using Egger's test, calculating the fail-safe  $N$ , and  $p$ -curve analysis to assess for potential

*p*-hacking. All analyses will be conducted in R using the package “dmetar” (Harrer et al., 2019), which provides tools and functionalities for conducting meta-analyses. This package allows researchers to conduct meta-analyses with multilevel models and random or fixed effects.

## Chapter 5: Results

### Overall Estimates of Individual Differences and Perceptual Deterrence

#### Descriptives

Overall, there were a total of  $k = 22$  studies across the dependent variables of interest (i.e., perceptions of risk, social costs, and rewards).<sup>2</sup> These studies yielded  $n = 178$  estimates, with some studies containing numerous estimates as a result of multiple measures of IDs and perceptual deterrence. As illustrated in Table 2, estimates of IDs and perceptions of risk were the most prevalent, followed by social costs, with perceptions of rewards being the least prevalent. Self-control, gender, peers, and morality were the most prevalent IDs. More information on each study is included in Table A1 in the appendix.

Table 2. Number of estimates and studies for focal constructs.

Construct	All	Certainty of Risk	Social Costs	Rewards
Anger	4 (2)	2 (2)	1 (1)	1 (1)
Conscientiousness	2 (1)	2 (1)	0 (0)	0 (0)
Emotionality	5 (3)	5 (3)	0 (0)	0 (0)
Executive function	3 (1)	1 (1)	1 (1)	1 (1)
Fear	1 (1)	1 (1)	0 (0)	0 (0)
Gender	38 (12)	23 (12)	9 (5)	6 (3)
Morality	25 (10)	15 (10)	6 (4)	4 (3)
Negative affect	6 (4)	6 (4)	0 (0)	0 (0)
Peers	31 (8)	20 (8)	6 (3)	5 (2)
Positive affect	3 (2)	3 (2)	0 (0)	0 (0)
Psychopathy	12 (1)	4 (1)	4 (1)	4 (1)
Self-control	48 (16)	31 (16)	9 (5)	8 (4)
Total	178 (22)	113 (22)	36 (7)	29 (5)

Note: Each cell contains the respective number of estimates with the number of studies in parentheses.

#### Assessment of Heterogeneity

Cochran's  $Q$  ( $Q = 3574.29$ ;  $df = 177$ ) was significant ( $p < .001$ ) suggesting larger

<sup>2</sup> One study (Cihan & Tittle, 2019) exhibited emirical patterns that were difficult to interpret. After contacting the author, the concerns were unresolved. Therefore, the study was excluded from the analyses.

differences in variation across studies rather than within. Higgin's & Thompson's  $I^2$  suggested that only 5 percent of variability in the effect sizes are caused by sampling error. Thus, nearly 95 percent [95%CI: 94.6%; 95.5%] of variability is estimated to be in either estimates or the studies in which they are nested. Finally, a tau-squared larger than 0 ( $\tau^2 = 0.027$  [95%CI: 0.022; 0.034]) suggests that a random effects model would yield different results from a fixed-effects model. Due to these results, a multi-level random effects model was conducted to derive a summary estimate from the collected estimates.

### **Analysis**

The results from the multi-level random-effects model using restricted maximum likelihood provided an overall estimate of Fisher's  $z(r) = .153$  ( $SE = 0.028$ ,  $t = 5.597$   $p < .001$  [95%CI: 0.100; 0.209]) from 178 estimates nested within 22 studies. This corresponded with  $r = 0.152$ , a modest but significant effect of IDs on PCC. Given the substantial heterogeneity, the pooled effects for risk, social costs, and rewards, and the pooling of bivariate and partial regression estimates, a moderation analysis was used to assess whether different outcome variables (i.e., risk, social costs, and rewards) and analysis type (i.e., bivariate or multivariable) significantly affect (i.e., moderate) the pooled estimate. The results of the meta-regression exhibited in Table 3 suggested that both the dependent variable of interest and analysis type were significant covariates ( $F_{(3, 174)} = 4.946$ ,  $p = 0.003$ ). Although perceptions of risk ( $b = -0.060$ ,  $SE = 0.034$ ,  $t = -1.778$   $p = 0.077$  [95%CI: -0.126; 0.007]) was not significant, perceptions of social costs was significant ( $b = -0.104$ ,  $SE = 0.035$ ,  $t = -2.977$ ,  $p = 0.003$  [95%CI: -0.172; -0.035]), with perceptions of reward as the reference group.

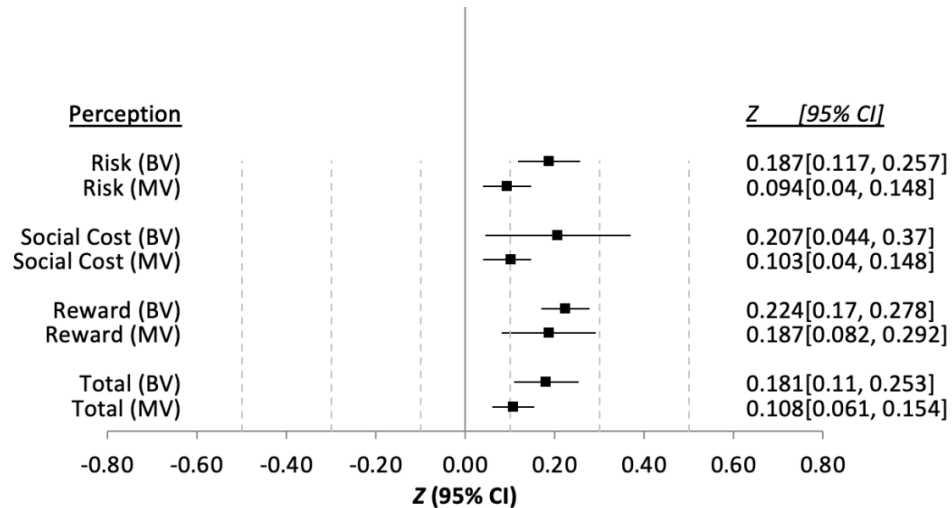
Table 3. Meta-regression of dependent variables and analysis type

Covariate	Z	SE	t	p	95%-CI
DV: Reward (reference)	0.310	0.055	5.657	<0.001	[0.202; 0.418]
DV: Risk	-0.060	0.034	-1.778	0.077	[-0.126; 0.007]
DV: Social Costs	-0.104	0.035	-2.977	0.003	[-0.172; -0.035]
Multivariable	-0.071	0.029	-2.462	0.015	[-0.127; -0.014]

Note. Multivariable estimate is in reference to bivariate estimate.

These results suggested that IDs, as a whole, have the strongest association with perceptions of reward and the weakest with perceptions of social costs.<sup>3</sup> Perceptions of risk was between these two extremes. Further, the covariate for analysis type suggested that multivariable analyses provided significantly smaller effects than bivariate analyses ( $b = -0.071$ ,  $SE = 0.029$ ,  $t = -2.462$ ,  $p = 0.015$  [95%CI: -0.127; -0.014]). The estimates for each PCC and the pooled total estimates for the bivariate and multivariable estimates are visualized in Figure 3.

Figure 3: Pooled estimates for risk, social cost, rewards, and total.



Notes. BV = bivariate, MV = multivariable; pooled estimate of social costs (BV) was derived after the anomalous results were excluded.

<sup>3</sup> These results are derived from the entire sample and have not been adjusted for anomalous estimates. Anomalous coefficients are discussed within each section (risk, social costs, reward).

## Perceptions of Risk

### Pooled estimate

There were  $n = 65$  bivariate estimates derived from  $k = 18$  studies on the association between IDs and perceptions of risk. The results of the multi-level meta-analysis, displayed as the pooled estimate in Table 4, suggested that there was a significant, moderate association ( $Z(r) = 0.187$ ,  $SE = 0.035$ ,  $t = 5.345$ ,  $p < .001$  [95%CI: 0.117; 0.257]) between IDs and perceptions of risk.

Table 4. Pooled and subgroup estimates of individual differences on perceptions of risk.

Variable	Bivariate			Multivariable		
	<i>n</i>	<i>Z</i>	95%-CI	<i>n</i>	<i>Z</i>	95%-CI
Anger	1	-0.0490	[-0.3771; 0.2901]	1	-0.0300	[-0.4416; 0.3920]
Conscientiousness	2	0.1737	[-0.2757; 0.5608]	0	--	--
Emotionality	4	0.2077	[ 0.1273; 0.2853]	1	0.1800	[-0.1948; 0.5089]
Executive function	0	--	--	1	0.0510	[-0.2769; 0.3682]
Fear	1	0.1610	[-0.1832; 0.4700]	0	--	--
Gender	11	0.1819	[ 0.1045; 0.2572]	12	0.0954	[ 0.0458; 0.1446]
Morality	9	0.2851	[ 0.1155; 0.4386]	6	0.2475	[ 0.1141; 0.3722]
Negative affect	5	0.4022	[-0.0885; 0.7358]	1	-0.100	[-0.4748; 0.3055]
Peers	10	0.2131	[ 0.1449; 0.2793]	10	0.0389	[-0.0069; 0.0845]
Positive affect	2	-0.0085	[-0.6135; 0.6027]	1	0.0800	[-0.3237; 0.4591]
Psychopathy	2	0.2120	[ 0.1606; 0.2622]	2	0.1342	[-0.0448; 0.3049]
Self-control	18	0.1989	[ 0.1480; 0.2488]	13	0.0626	[ 0.0051; 0.1197]
Pooled Estimate	65	0.1871	[ 0.1172; 0.2571]	48	0.0943	[ 0.0403; 0.1482]

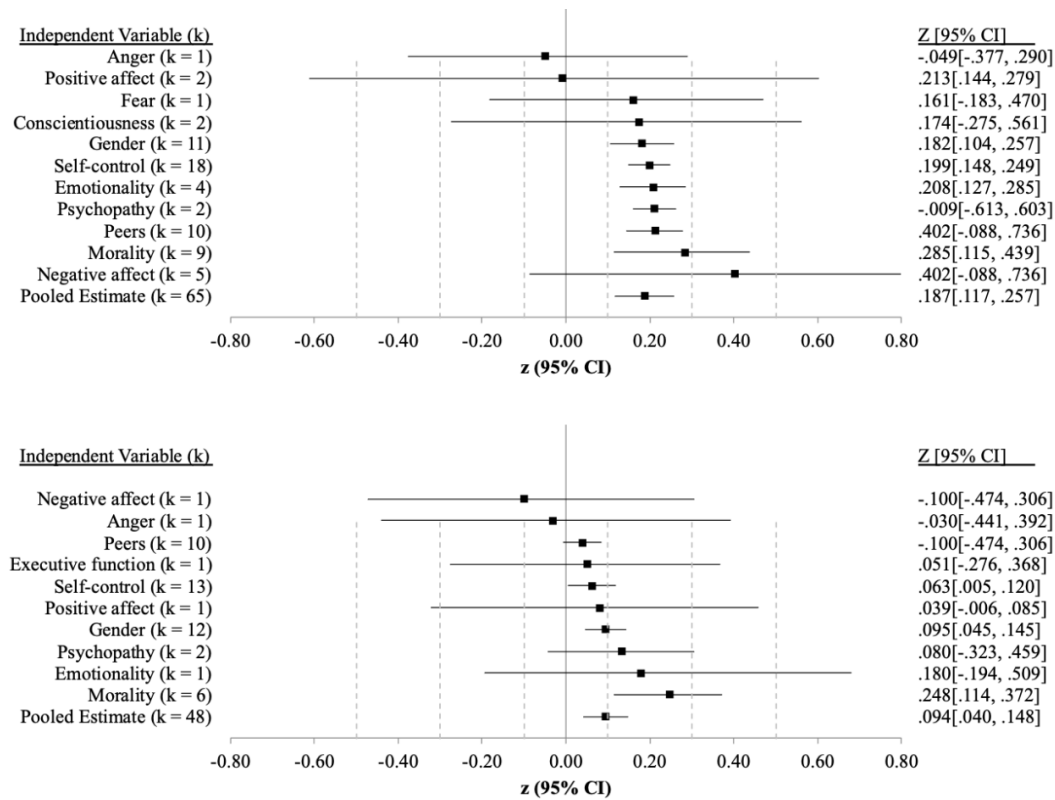
Note. *n* = number of estimates.

A total of  $n = 48$  estimates derived from  $k = 8$  studies reported partial correlation coefficients for the association between IDs and perceptions of risk. The results suggested a significant but attenuated relationship compared to the bivariate results ( $Z(r) = 0.094$ ,  $SE = 0.027$ ,  $t = 3.516$ ,  $p = 0$  [95%CI: 0.040; 0.148]).

### **Subgroup analysis**

A multi-level meta-analysis (estimates nested within studies) was not possible for the subgroup analyses due to limited number of studies containing the independent variables of interest. Therefore, the results for the subgroup analyses are derived from a random effects model of the estimates of IDs on perceived risk. The same process is used in the social costs and rewards subsections. Using Cochran's  $Q$ , the results suggested significant differences between in the overall effect of IDs on perceived risk for the bivariate ( $Q = 91.18$ ,  $df = 10$ ,  $p < 0.001$ ) and multivariable ( $Q = 54.75$ ,  $df = 9$ ,  $p < 0.001$ ). Table 4 displays the results of the subgroup analyses. The bivariate associations suggested that 6 of 11 IDs had an association with perceptions of risk. These were emotionality ( $k = 4$ ,  $z(r) = 0.208$ , [95%CI: 0.127; 0.285]), gender ( $k = 11$ ,  $z(r) = 0.182$ , [95%CI: 0.105; 0.257]), morality ( $k = 9$ ,  $z(r) = 0.285$ , [95%CI: 0.116; 0.439]), peers ( $k = 10$ ,  $z(r) = 0.213$ , [95%CI: 0.145; 0.279]), psychopathy ( $k = 2$ ,  $z(r) = 0.212$ , [95%CI: 0.161; 0.262]), and self-control ( $k = 18$ ,  $z(r) = 0.199$ , [95%CI: 0.148; 0.249]). The multivariable studies suggested that only 3 of the 11 IDs suggested a significant association with perceived risk. These include gender ( $k = 12$ ,  $z(r) = 0.095$ , [95%CI: 0.046; 0.145]), morality ( $k = 6$ ,  $z(r) = 0.248$ , [95%CI: 0.114; 0.372]), and self-control ( $k = 13$ ,  $z(r) = 0.063$ , [95%CI: 0.005; 0.120]). These results are visualized in Figure 4.

Figure 4: Subgroup bivariate (top) and multivariable (bottom) estimates of individual differences on perceptions of risk.



### Moderation Analyses

The moderation analyses exhibited in Table 5 suggest significant sample and study design influence on the pooled estimate of IDs on perceptions of risk. Specifically, in reference to adolescents, college ( $b = -0.124$ ,  $SE = 0.068$ , [95%CI: -0.259; 0.011],  $p = 0.071$ ) and general population ( $b = -0.157$ ,  $SE = -0.157$ , [95%CI: -0.289; -0.024],  $p = 0.021$ ) samples pointed to reduced associations between IDs and perceptions of risk, suggesting that age attenuates the relationship between IDs and perceived risk. Although offending samples reduced the estimate of IDs on perceived risk, the analysis did not suggest a significant impact ( $b = -0.091$ ,  $SE = 0.076$ , [95%CI: -0.242; 0.060],  $p = 0.234$ ). Regarding the study design, controlling for experiential effects reduced the overall estimate ( $b = -0.093$ ,  $SE = 0.046$ , [95%CI: -0.185; -0.002],  $p = 0.046$ ) and longitudinal designs did not make a significant impact ( $b = 0.029$ ,  $SE =$



0.044, [95%CI: -0.058; 0.116],  $p = 0.510$ ).

Table 5. Moderation analyses of sample characteristics and study design on perceptions of risk

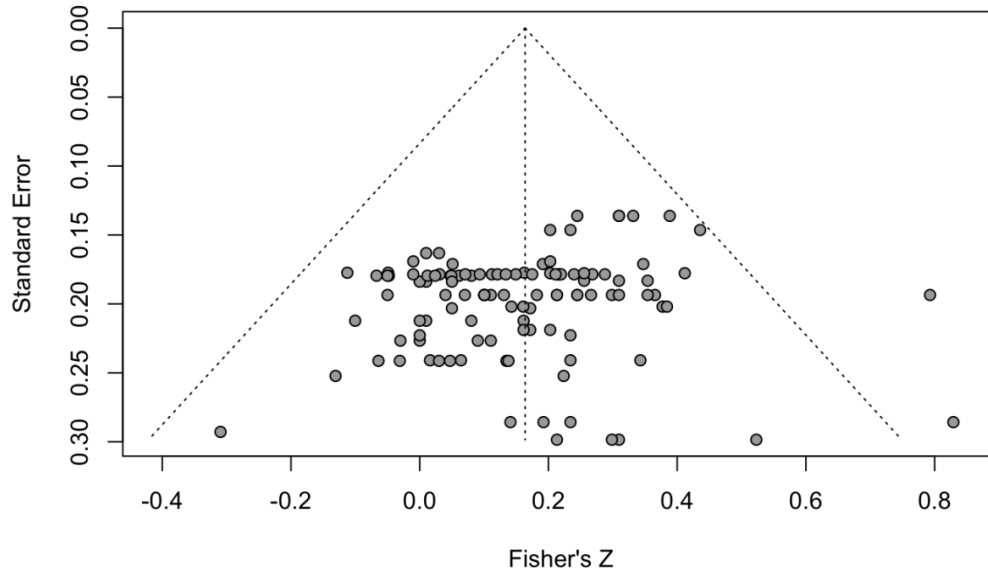
	<i>b</i>	<i>SE</i>	<i>95%CI</i>	<i>p</i>
Intercept (sample characteristics)	0.2531***	0.0503	[0.1534; 0.3529]	<.0001
Age				
Adolescents (reference)	--	--	--	--
College	-0.1241	0.0681	[-0.2591; 0.0109]	0.0712
Population	-0.1568*	-0.1568	[-0.2892; -0.0244]	0.0207
Offending	-0.0910	0.0761	[-0.2419; 0.0598]	0.2341
Intercept (study design)	0.1516***	0.0320	[0.0882; 0.2151]	<.0001
Experiential controlled	-0.0932*	0.0463	[-0.1849; -0.0015]	0.0463
Longitudinal	0.0290	0.0439	[-0.0580; 0.1161]	0.5096

Note. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .0001$ ;  $k = 22$ ;  $n = 113$ .

### Bias Assessments

The funnel plot of estimates from the association between IDs and perceptions of risk displayed in Figure 5 suggested no publication bias, given the estimates are evenly distributed around the mean with minimal skew. Egger's test further supported the symmetry observed in the funnel plot with a non-significant association of the estimates and the standard errors ( $b = -.075$ , [95%CI: -1.626, 0.1350],  $p = 0.100$ ). The fail-safe N is estimated at  $n = 3,078$ , suggesting that an inordinate number of null estimates would be needed to negate the results of the meta-analysis of IDs and perceptions of risk. Finally, the  $p$ -curve analysis displayed in Figure A1 suggested significant right skew ( $p < .001$ ) in the significant  $p$ -values of the estimates and no evidence of a flat distribution ( $p > 0.999$ ). The right skew in the  $p$ -curve analysis indicates that the significant estimates assessed were more robust, with a concentration of  $p$ -values closer .01 than .05. Taken together, these results exhibit no evidence of publication bias and supported the results suggesting an evidential value (see Simonsohn et al., 2014) of the association between IDs and perceptions of risk.

Figure 5. Funnel plot of the estimates and standard errors of perceptions of risk.



Note: Egger's test suggests no significant association between the estimates and standard errors ( $b = -.0745$ , [95%CI: -1.626, 0.1350],  $p = 0.100$ ).

### Perceptions of Social Costs

#### Pooled estimate

There were  $n = 19$  bivariate estimates derived from  $k = 5$  studies on the association between IDs and the perceived social costs of offending. The results of the multi-level meta-analysis exhibited in Table 6 suggested that there was no significant pooled bivariate association ( $z(r) = 0.073$ ,  $SE = 0.147$ ,  $t = 0.497$ ,  $p = 0.624$  [95%CI: -0.236; 0.383]) between individual traits and social costs. However, further inspection of the results pointed toward two extreme outliers stemming from one study (Paternoster et al., 1983). These outliers were both in the opposite direction of theoretical expectation, with one estimate reporting a significant negative association between moral belief and social costs ( $r = -.60$ ) and a significant positive association between being male and social costs ( $r = .26$ ). Further inspection of those estimates in the multivariable model from the same study (after the addition of control variables) using the same sample,

reported more reasonable estimates that contradict the directionality of bivariate estimates (morality:  $\beta = .42, p < .001$ ; gender:  $\beta = -.05, p > .05$ ). Once these estimates were excluded, the pooled bivariate estimate ( $n = 17$ ) of IDs on social costs displayed in Table 6 suggested a moderate significant association, with nearly half the standard error ( $z(r) = 0.207, SE = 0.077, t = 2.697, p = 0.016$  [95%CI: 0.044; 0.370]). This is likely a result of the reduced variation created by the irregular estimates mentioned.

Table 6. Pooled and subgroup estimates of individual differences on perceptions of social costs.

Variable	Bivariate			Multivariable		
	<i>n</i>	<i>Z</i>	95%-CI	<i>n</i>	<i>Z</i>	95%-CI
Anger	0	--	--	1	0.05	[-0.3749; 0.4576]
Conscientiousness	0	--	--	0	--	--
Emotionality	0	--	--	0	--	--
Executive function	0	--	--	1	0.09	[-0.2403; 0.4016]
Fear	0	--	--	0	--	--
Gender <sup>†</sup>	4	0.1158	[-0.0288; 0.2556]	4	0.0773	[ 0.0450; 0.1094]
Morality <sup>†</sup>	2	0.4953	[-0.5676; 0.9391]	3	0.2012	[-0.2387; 0.5725]
Negative affect	0	--	--	0	--	--
Peers	4	0.1341	[ 0.0678; 0.1992]	2	0.0506	[-0.2461; 0.3387]
Positive affect	0	--	--	0	--	--
Psychopathy	2	0.1021	[-0.2756; 0.4524]	2	0.0469	[-0.4603; 0.5311]
Self-control	5	0.1738	[ 0.0257; 0.3144]	4	0.0445	[-0.0053; 0.0942]
Pooled Estimate	17	0.2072	[0.0443; 0.3700]	17	0.1026	[0.0258; 0.1793]

Note. *n* = number of estimates; <sup>†</sup>a bivariate estimate from Paternoster et al. (1983) omitted due to concerns outlined in the text.

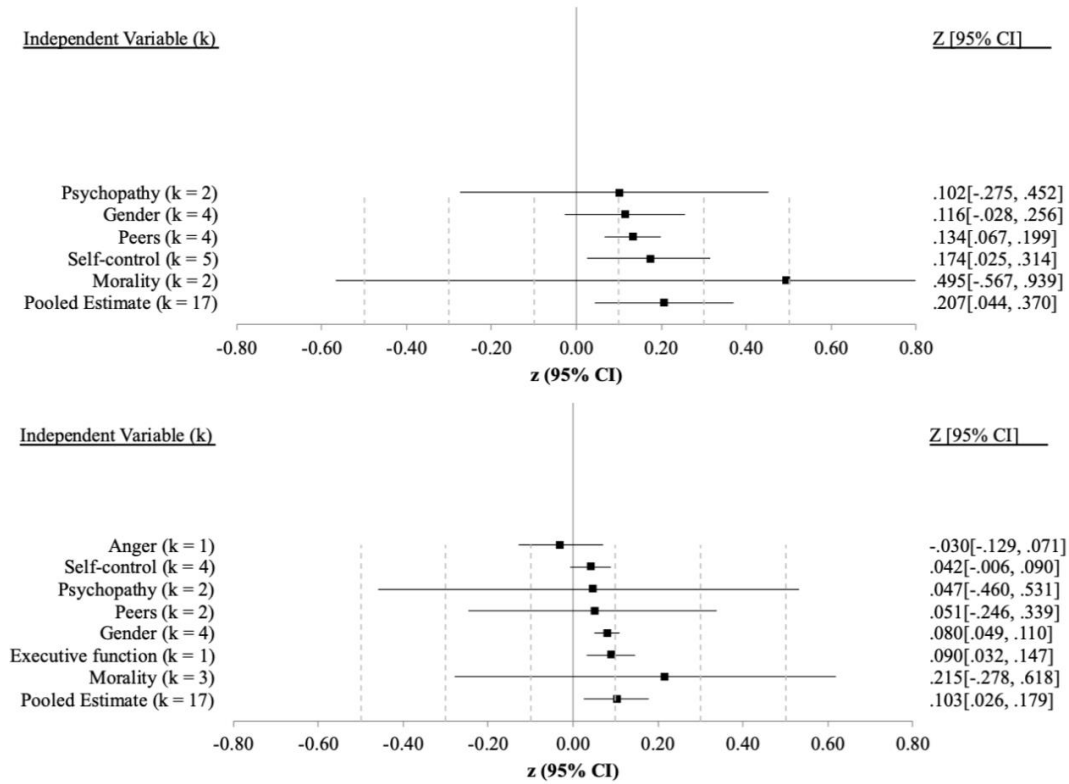
A total of  $n = 17$  estimates derived from  $k = 4$  studies reported partial correlation coefficients for the association between IDs and perceptions of social costs. The results suggested a significant but attenuated relationship compared to the bivariate results that did not include the two outliers ( $z(r) = 0.103, SE = 0.036, t = 2.834, p = 0.012$  [95%CI: 0.026; 0.179]). Relative to the initial pooled bivariate estimate (including the two outliers), the results of the partial effects would suggest an increase in magnitude, an unlikely scenario that further justifies removing the two bivariate outliers. Further assessments of subgroup, moderation, and bias are

conducted with the exclusion of the two outlier estimates.

### **Subgroup analysis**

Cochran's Q suggested significant subgroup differences in the effect of IDs on perceived risk for the bivariate ( $Q = 18.88$ ,  $df = 4$ ,  $p < 0.001$ ) but not the multivariable ( $Q = 7.77$ ,  $df = 6$ ,  $p = 0.2555$ ) pooled estimate. Table 6 displays the results of the subgroup analyses. The bivariate associations suggested that 2 of 5 IDs have an association with social costs. These included peers ( $k = 4$ ,  $z(r) = 0.134$ , [95%CI: 0.068; 0.199]) and self-control ( $k = 5$ ,  $z(r) = 0.174$ , [95%CI: 0.026; 0.314]). Of the partial individual difference estimates, only gender ( $k = 4$ ,  $z(r) = 0.0773$ , [95%CI: 0.045; 0.109]) exhibited an association. Although gender (0 = female) is only significant in the multivariable estimates, the bivariate estimate was larger but with a wider confidence interval that overlaps with 0 ( $k = 4$ ,  $z(r) = 0.127$ , [95%CI: -0.025; 0.273]). Peers, and self-control were attenuated out of significance when comparing bivariate and partial estimates. Although morality had the strongest association in both the bivariate ( $k = 2$ ,  $z(r) = 0.495$ , [95%CI: -0.568; 0.939]) and multivariable subgroup analyses ( $k = 3$ ,  $z(r) = 0.201$ , [95%CI: -0.239; 0.573]), the confidence intervals overlapped with 0, precluding significant findings. These results are visualized in Figure 6.

Figure 6: Subgroup bivariate (top) and multivariable (bottom) estimates of individual differences on perceptions of social costs.



Note. Estimates for social costs do not include anomalous gender ( $n = 1$ ) or morality ( $n = 1$ ) coefficients as discussed in the Results section.

### Moderation Analyses

The moderation analyses of sample characteristics and study design exhibited no significant influence on the pooled estimates. However, given the limited number of studies that reported multivariate estimates related to IDs and social costs, the moderators were reviewed here with regards to their coefficients and confidence intervals rather than statistical significance. Regarding sample characteristics, results in Table 7 suggested that college samples ( $b = 0.061$ ,  $SE = 0.168$ , [95%CI: -0.280; 0.402],  $p = 0.719$ ) and general population samples ( $b = 0.015$ ,  $SE = 0.232$ , [95%CI: -0.458; 0.488],  $p = 0.950$ ) both exhibited a sizable, yet nonsignificant effect on

the intercept ( $b = 0.084$ ,  $SE = 0.136$ , [95%CI: -0.191; 0.360],  $p = 0.538$ ). These coefficients should be viewed with caution as their confidence intervals are large. There was substantial overlap across studies in their use of offending samples and the age of the samples, precluding an analysis of both in the same model as they are highly correlated. Therefore, moderation estimates were not calculated for offending as a sample characteristic.<sup>4</sup> Participants who reported being arrested in Wave III ( $n = 427$ ) were excluded from the sample to preserve temporal order between offending (Wave III) and arrest (Wave IV).

Table 7. Moderation analyses of sample characteristics and study design of perceptions of social costs.

	<i>b</i>	<i>se</i>	95%CI	<i>p</i>
Intercept (sample characteristics)	0.0843	0.1355	[-0.1913; 0.3599]	0.5378
Age				
Adolescents (reference)	--	--	--	--
College	0.0610	0.1678	[-0.2804; 0.4024]	0.7185
Population	0.0148	0.2324	[-0.4580; 0.4876]	0.9490
Offending	--	--	--	--
Intercept (study design)	0.1027	0.0730	[-0.0459; 0.2513]	0.1691
Experiential controlled	0.0731	0.0671	[-0.0635; 0.2097]	0.2840
Longitudinal	-0.0146	0.0734	[-0.1639; 0.1346]	0.8433

Note. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .0001$ ;  $k = 7$ ;  $n = 36$ .

Study design moderation results were similar to those of sample characteristics in that the limited sample size likely reduced the capacity for statistically significant findings. Nonetheless, the results are discussed to a limited capacity regarding their effect size and confidence intervals. Including experiential effects ( $b = 0.073$ ,  $SE = 0.067$ , [95%CI: -0.064; 0.210],  $p = 0.284$ ) increased the intercept ( $b = 0.103$ ,  $SE = 0.073$ , [95%CI: -0.046; 0.251],  $p = 0.284$ ) by more than half, while longitudinal analyses exhibited a modest, nonsignificant effect ( $b = -0.015$ ,  $SE = 0.073$ , [95%CI: -0.164; 0.135],  $p = 0.843$ ). Again, neither effect was significant due to their wide

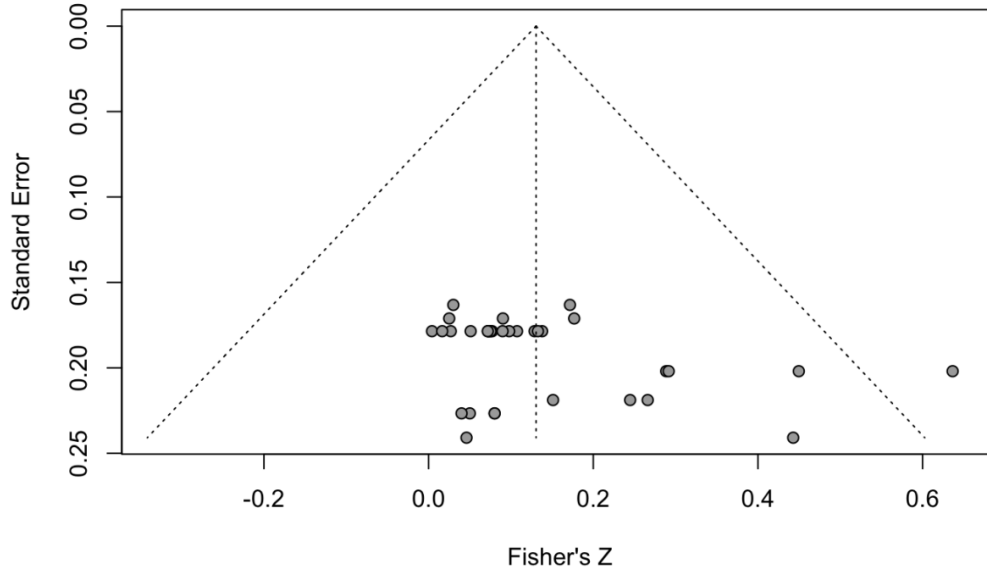
<sup>4</sup> To confirm, an additional analysis was conducted using only offending as a moderator. The results suggested no significant effect ( $b = -0.057$ ,  $SE = 0.135$ , [95%CI: -0.332; 0.217],  $p = 0.674$ ).

confidence intervals, likely a consequence of the small sample of studies. More generally, the entire moderation section of the multivariable effects of IDs on the perceived social costs of offending has to be viewed with caution as the sample of studies was small ( $k = 7$ ) therefore limiting the confidence associated with the derived estimates.

### **Bias Assessments**

Figure 7 displays the funnel plot of the estimates of IDs on the perceptions of social costs. The plot suggested some skew toward larger estimates. All estimate estimates were larger than 0, however, suggesting that although the results are skewed, there is no evidence of a null effect. Egger's test yielded a significant association of the estimates and the standard errors ( $b = 2.270$ , [95%CI: .260, 4.280],  $p = 0.034$ ). The fail-safe N is estimated at  $n = 184$ , which is much less than the estimate for perceptions of risk, but a large enough number to provide some confidence in the pooled estimate. Finally, the  $p$ -curve analysis displayed in Figure A2 suggest significant right skew ( $p < .001$ ) in the significant  $p$ -values of the estimates and no evidence of a flat distribution ( $p > 0.999$ ). Although these results suggest some evidence of publication bias, without the larger estimates observed in Figure 7 that skew the results, the estimate is still sizable.

Figure 7. Funnel plot of the estimates and standard errors of perceptions of social costs.



Note: Egger's test suggests a significant association between the estimates and standard errors ( $b = 2.270$ , [95%CI: .260, 4.280],  $p = 0.034$ ).

### Perceptions of Reward

#### Pooled estimate

A total of  $k = 3$  studies produce  $n = 13$  bivariate estimates of the association between IDs and perceptions of rewards. The results of the multi-level meta-analysis displayed in Table 8 suggested that there was a significant moderate bivariate association ( $z(r) = 0.224$ ,  $SE = 0.025$ ,  $t = 9.048$ ,  $p < 0.001$  [95%CI: 0.17; 0.278]). A total of  $k = 3$  produced 15 partial estimates deriving a significant multivariable pooled estimate ( $z(r) = 0.187$ ,  $SE = 0.049$ ,  $t = 3.823$ ,  $p = 0.002$  [95%CI: 0.082; 0.292]) that was only slightly attenuated compared to the bivariate estimate.



Table 8. Pooled and subgroup estimates of individual differences on perceptions of rewards.

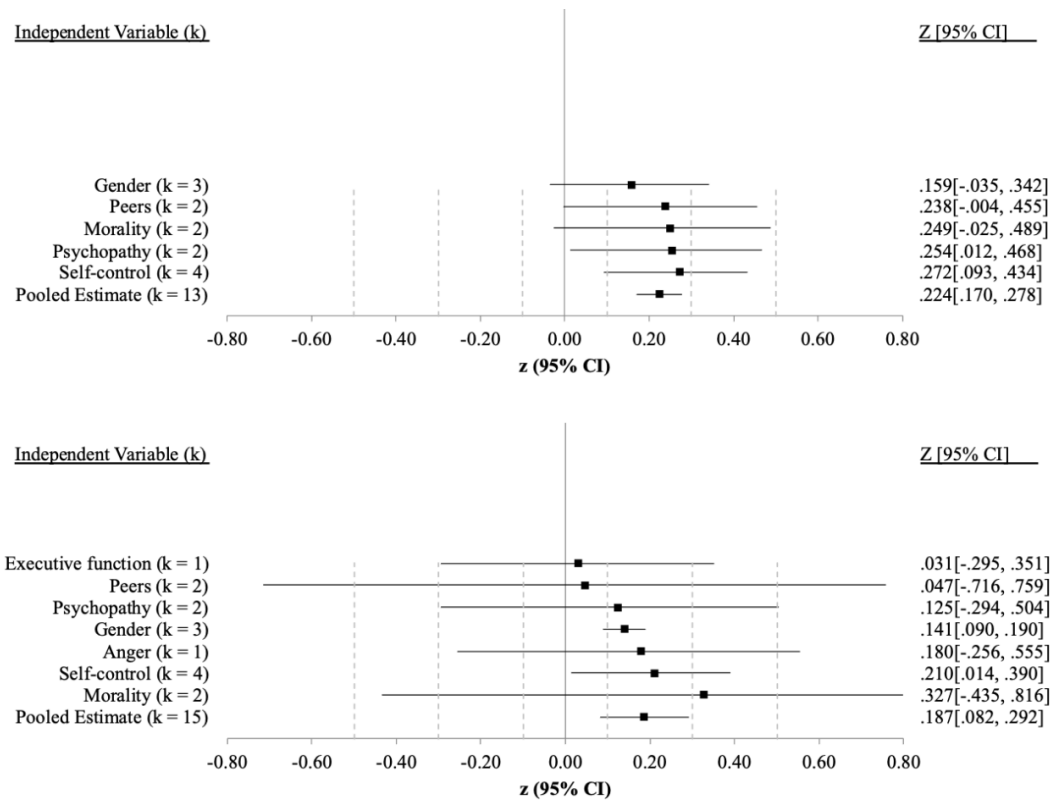
Variable	Bivariate			Multivariable		
	<i>n</i>	<i>Z</i>	95%- <i>CI</i>	<i>n</i>	<i>Z</i>	95%- <i>CI</i>
Anger	0	--	--	1	0.1800	[-0.2564; 0.5554]
Conscientiousness	0	--	--	0	--	--
Emotionality	0	--	--	0	--	--
Executive function	0	--	--	1	0.0310	[-0.2953; 0.3508]
Fear	0	--	--	0	--	--
Gender	3	0.1588	[-0.0355; 0.3415]	3	0.1408	[ 0.0909; 0.1901]
Morality	2	0.2492	[-0.0254; 0.4888]	2	0.3269	[-0.4351; 0.8161]
Negative affect	0	--	--	0	--	--
Peers	2	0.2384	[-0.0043; 0.4547]	2	0.0471	[-0.7161; 0.7589]
Positive affect	0	--	--	0	--	--
Psychopathy	2	0.2544	[ 0.0126; 0.4680]	2	0.1248	[-0.2949; 0.5041]
Self-control	4	0.2718	[ 0.0931; 0.4335]	4	0.2100	[ 0.0141; 0.3904]
Pooled Estimate	13	0.2243	[0.1703; 0.2783]	15	0.1869	[ 0.0821; 0.2918]

Note. *n* = number of estimates.

### Subgroup analysis

Cochran's *Q* test of heterogeneity suggested significant differences in overall effect of IDs on perceived risk for the bivariate ( $Q = 353.56$ ,  $df = 13$ ,  $p < 0.001$ ) and multivariable ( $Q = 179.10$ ,  $df = 14$ ,  $p < 0.001$ ) subgroups. Table 8 displays the results from the subgroup analyses. The bivariate associations suggested that 2 of the 5 IDs exhibited an association with perceptions of reward. These included psychopathy ( $k = 2$ ,  $z(r) = 0.254$ , [95%CI: 0.013; 0.468]) and self-control ( $k = 4$ ,  $z(r) = 0.272$ , [95%CI: 0.093; 0.434]). Only 2 of 7 IDs with partial regression estimates suggested a significant association. These included gender ( $k = 3$ ,  $z(r) = 0.141$ , [95%CI: 0.091; 0.190]) and self-control ( $k = 4$ ,  $z(r) = 0.210$ , [95%CI: 0.014; 0.390]). These results are visualized in Figure 8.

Figure 8: Subgroup bivariate (top) and multivariable (bottom) estimates of individual differences on perceptions of reward.



### Moderation Analyses

The moderation analyses displayed in Table 9 suggested significant sample and study design influences on the pooled estimate. Specifically, in reference to adolescents, the general population ( $b = 0.260$ ,  $SE = 0.122$ , [95%CI: 0.073; 0.446],  $p = 0.008$ ) samples exhibited increased associations between IDs and perceptions of rewards, suggesting that age amplifies this relation, in contrast to expectation and results from the perceptions of risk analyses. This is also evident in the college samples ( $b = 0.070$ ,  $SE = 0.053$ , [95%CI: -0.043; 0.175],  $p = 0.226$ ), although not significant. In contrast to sample differences, study design did not exhibit any effects on the estimate of IDs on perceived rewards for experiential effect controls ( $b = -0.101$ ,  $SE = 0.053$ , [95%CI: -0.211; 0.008],  $p = 0.069$ ) or longitudinal designs ( $b = -0.033$ ,  $SE = 0.053$ ,

[95%CI: -0.143; 0.076],  $p = 0.538$ ).

Table 9. Moderation analyses of sample characteristics and study design of perceptions of rewards.

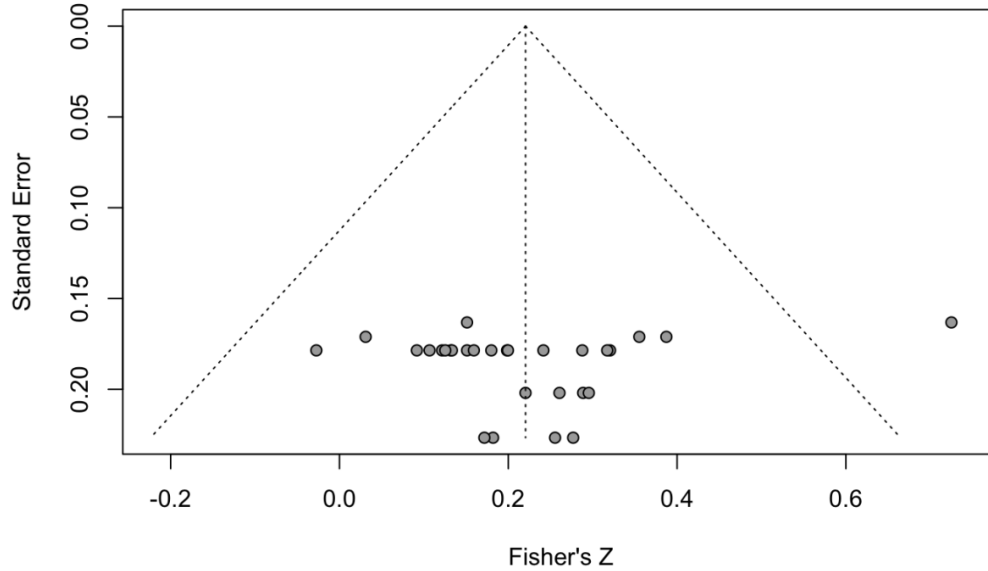
	<i>b</i>	<i>se</i>	95%CI	<i>p</i>
Intercept (sample characteristics)	0.1786***	0.0282	[0.1207; 0.2365]	<.0001
Age				
Adolescents (reference)	--	--	--	--
College	0.0659	0.0531	[-0.0433; 0.1752]	0.2258
Population	0.2595**	0.1223	[0.0733; 0.4456]	0.0081
Offending <sup>†</sup>	-0.1179	0.0751	[-0.2720; 0.0361]	0.1279
Intercept (study design)	0.2956	0.0477	[0.1975; 0.3936]	<.0001
Experiential controlled	-0.1011	0.0532	[-0.2105; 0.0083]	0.0686
Longitudinal	-0.0332	0.0532	[-0.1426; 0.0761]	0.5378

Note. <sup>†</sup>offending samples were conducted in a separate analysis due to collinearity concerns with age; \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .0001$ ;  $k = 5$ ;  $n = 29$ .

### Bias Assessments

The funnel plot of estimates of the association and standard errors of IDs and perceptions of rewards is displayed in Figure 9. Visually, it is unclear whether there is publication bias as an outlier skews the results. Further, two other estimates with relatively larger standard errors are the next largest estimates. Despite the visual ambiguity of the funnel plot, Egger's test finds no evidence for an association between the estimates and the standard errors ( $b = -.720$ , [95%CI: -4.00, 2.560],  $p = 0.670$ ). The fail-safe N is estimated at  $n = 409$ , providing more confidence in the pooled estimate. Finally, the  $p$ -curve analysis in Figure A3 suggest significant right skew ( $p < .001$ ) in the significant  $p$ -values of the estimates and no evidence of a flat distribution ( $p > 0.999$ ). This observation is supported by the significance of the estimates, which are all  $p > .01$ . Taken together, these results suggest no evidence of publication bias and support the inference that there is an association between IDs and perceptions of rewards.

Figure 9. Funnel plot of the estimates and standard errors of perceptions of rewards.



Note: Egger's test suggests no significant association between the estimates and standard errors ( $b = -.720$ , [95%CI: -4.000, 2.555],  $p = 0.670$ ).

### Summary of Results

Overall, the current project meta-analyzed the extant associations between IDs and PCC within three domains: risk, social costs, and rewards. The overall estimates derived from the literature suggested that there is a relationship between IDs and each PCC. Further analyses of specific IDs revealed substantive differences in their associations with PCC. Additional moderation analyses also contextualized these estimates within the methodological differences in previous studies. The results suggested that the sampling frame, control variables, and analyses (i.e., cross-sectional or longitudinal) contributed to some of the variation across estimates and studies. Finally, tests of publication bias suggested evidence that the results are fairly robust to concerns about the file-drawer problem,  $p$ -hacking, and other concerns related to the extant literature.

## Chapter 6: Discussion

Theories of individual differences (IDs) have deep roots in criminology, stemming back to the 1700s. These theories generally contend that intrinsic differences across individuals account for behavioral differences. Although these theories have empirical backing, where variation in IDs have been found to correspond with variation in behavioral outcomes, these theories often lack the proximate mechanisms that connect developmental and sometimes stable characteristics with unpredictable and often variable behavioral outcomes.

Situational theories of offending focus on proximal factors that precipitate offending. These factors often are circumstantial and changing. Perceptions of risk and reward are situational in that in the consideration of offending behavior, these factors are relevant to the presented context. For example, in a scenario where a theft might occur, the perception of risk of apprehension may be contingent on factors such as the presence of a guardian. Situational theories are ideal for explaining the proximal precursors of offending behavior, and have received strong empirical backing in the criminology literature (Weisburd & Piquero, 2008). A gap in these theories, however, is that they often overlook the more distal causes of crime. Specifically, variation in perceptions of risk and reward likely vary across individuals (Altikriti & Nedelec, 2020), where personality or IDs can account for some of that variation.

Recent research in criminology has begun to merge the two perspectives of IDs and situational factors in predicting offending. These lines of research have specified that certain IDs, as developmental or distal factors, influence perceptions of risk and reward. This association in part explains variation in offending across individuals. This research suggests that IDs and situational factors are important antecedents of variation in offending. However, the combination of the two perspectives in an integrated model may more comprehensively explain offending. Importantly the merger of IDs and situational factors can uncover the mechanisms that link developmental influences with offending outcomes years later and explain the variation observed

across individuals in their perceptions of risk and reward.

The current project aimed to capitalize on the growing literature that assessed the relationship between IDs and perceptions of risk and reward. In this body of literature, studies suggest that IDs are associated with perceptions of risk and reward. Thus, the current project meta-analyzed the existing research assessing the association of a broad range of IDs with perceptions of risk and reward guided by three main research questions. First, what is the overall association between a range of IDs and perceptions of risk and reward? Second, which specific IDs are associated with perceptions of risk and reward? And third, under what study characteristics are these relationships observed?

## **Findings**

### **Overall**

The general results from the meta-analysis presented evidence of an association between IDs and all three perceptions of risk, social costs, and rewards. The combined association of  $z(r) = .181$  suggested a sizable association, although attenuated in the multivariable model to  $z(r) = .108$ . There was some heterogeneity in the estimates, however, with reward being most strongly tied to the perceptions outcomes, followed by risk, and the social costs. That perceptions of reward had the strongest association is an important finding for the literature for three reasons. First, control theories and deterrence theories traditionally viewed perceptions of reward as invariant across individuals. The assumption was that all individuals are equally motivated by inherent self-interest or hedonistic calculus. The results herein suggest otherwise. Specifically, of the three perceptions assessed, perceptions of reward suggest the strongest associations across individuals and their IDs.

Second, in collating the literature on the association of IDs on perceptions of risk, reward, and social costs, 178 estimates were gathered from 22 studies. The majority of those estimates ( $n = 133$ ,  $k = 22$ ) were for perceptions of risk, with social costs ( $n = 36$ ,  $k = 7$ ) coming in second

and rewards ( $n = 29, k = 5$ ) a close third. The concentration of estimates among perceptions of risk highlights a shortfall in the literature which is exacerbated by perceptions of reward being exhibiting the strongest association with IDs. Further exacerbating this pattern is that perceptions of reward have been found to be a stronger mediator of IDs (i.e., self-control) and offending outcomes than perceptions of risk or social costs (Altikriti, 2021).

Third, perceptions of reward had the least attenuation from the bivariate to multivariable pooled estimate. Attenuation in the estimates between the bivariate and multivariable pooled estimates have two explanations, both of which are due to overlapping empirical variation. The first and most worrisome is that there is some confounding between these variables. Specifically, including covariates in a model can remove variation due to an exogenous explanatory variable. For example, the link between deviant peers and perceptions of reward could be partially or fully accounted for by a common cause such as self-control. In this case, the relationship observed is spurious. The second explanation for the attenuation is that there is overlapping variation not due to confounding. For example, low self-control influences individuals to associate with delinquent peers, and associating with delinquent peers influences perceptions of reward. In this case, both concepts of self-control and delinquent peers are integral to a causal model but including one or the other as a covariate attenuates the bivariate relationship observed. Although perceptions of risk, social costs, and rewards each suggested an overall positive relationship with IDs, each outcome contained more nuanced findings.

### **Risk**

Perceptions of risk had the most estimates, with all significant estimates of IDs being positively associated. The bivariate pooled estimate of  $z(r) = .187$  was attenuated by nearly half in the multivariable estimate  $z(r) = .094$ . Further, in the bivariate estimates, of the 11 IDs six were significant (emotionality,  $n = 4$ ; gender,  $n = 11$ ; morality,  $n = 9$ ; peers,  $n = 10$ ; psychopathy,  $n = 2$ ; and self-control,  $n = 18$ ). However, five of six pooled estimates with  $n > 2$

constituent estimates were significant (emotionality,  $n = 4$ ; gender,  $n = 11$ ; morality,  $n = 9$ ; peers,  $n = 10$ ; self-control,  $n = 18$ ). It is important to note that once only  $n > 2$  estimates were used, the standard errors decreased, making significant findings more likely and reducing type II error. Limiting the estimates to  $n > 2$  limits some of concerns related to larger confidence intervals due to limited estimates. In the multivariable estimates, three of the ten IDs suggested a significant association (gender,  $n = 12$ ; morality,  $n = 6$ ; self-control,  $n = 13$ ), with three of four pooled estimates with  $n > 2$  being significant (gender,  $n = 12$ ; morality  $n = 6$ ; self-control,  $n = 13$ ). The larger proportion of significant estimates from  $n > 2$  pooled estimates suggests that increasing the pool of estimates addresses the wide confidence intervals observed in some estimates. Gender, morality, and self-control were the only estimates that were significant across the models, with morality exhibiting the largest magnitude followed by gender and then self-control.

### ***Moderation***

Beyond the general pooled estimates, the moderation analyses assessing the differential effects of sample and study design characteristics suggested two differences of note. First, in a population sample (i.e., not restricted to adolescents or college students) the association between IDs and perceptions of risk is significantly attenuated, potentially suggesting that as individuals age, their IDs have less of an influence on their perceptions of risk. This pattern may be a result of the lived experience that comes with age (Anwar & Loughran, 2011), gradually accumulating and becoming more important than IDs. This pattern corresponds with the literature that suggests desistance with age across individuals (Sampson & Laub, 2003).

Second, accounting for a measure of experiential effects (e.g., prior offending) significantly reduced the derived pooled estimate. As previously discussed, this could mean two things. First, experiential effects can shape both IDs and perceived risk, creating a spurious association between them. Although this is possible, it is unlikely that IDs are shaped by



experiences given that IDs (e.g., self-control or psychopathy) are considered relatively stable over time (Barnes et al., 2017; Lynam et al., 2008), although not without exception. The alternative explanation is that IDs influence behavior and perceptions of risk, where removing covariation between the experiential effects and perceptions of risk removes some of the variation due to IDs. Addressing these explanations is beyond the scope of the current project, but a potential research question for future research.

### **Social costs**

Although perceptions of social costs suggest a similar story to perceptions of risk, the fewer estimates ( $n = 34$ ) caused more of the estimates to fall out of significance. The bivariate pooled estimate of  $z(r) = .207$  saw only two of the five estimates being significant (peers,  $n = 4$ ; self-control,  $n = 5$ ), with the same two from three pooled estimates with  $n > 2$  being significant. The multivariable results  $z(r) = .103$  had only two of seven significant (gender,  $n = 4$ ; executive function,  $n = 1$ ) and one of three  $n > 2$  estimates significant (gender  $n = 4$ ). Although IDs exhibited a significant overall association with perceptions of social costs, the constituent relationships were more tentative with smaller estimates and larger confidence intervals compared to perceptions of risk.

### **Moderation**

Moderation analyses of the sample and study design characteristics did not exhibit any significant findings, where age, experiential controls, or longitudinal design do not seem to influence the association between IDs and perceptions of social costs. Although this may suggest that age or experience do not influence the association between IDs and perceptions of social costs, it is likely that the relatively large standard errors and derived confidence intervals precluded significant results in the moderation analyses. Future research is encouraged to assess these relationships as there is currently not enough research to derive substantive conclusions regarding the moderation analyses.

### **Rewards**

Of the three perceptions tested herein, rewards exhibited the strongest relationship with IDs. However, this statement comes with two caveats. First, perceptions of reward had the fewest constituent estimates. And, perhaps as a result of the first caveat, the second is that the standard errors of the estimates were the largest for perceptions of reward. Of the bivariate pooled estimates, only two of the five bivariate estimates were significant (psychopathy,  $n = 2$ ; self-control,  $n = 4$ ) and one of two  $n > 2$  estimates were significant (self-control,  $n = 4$ ). Further, two of seven multivariate estimates were significant (gender,  $n = 3$ ; self-control,  $n = 4$ ; as well as all two of  $n > 2$  pooled estimates (gender,  $n = 3$ ; self-control,  $n = 4$ ). Although these are fewer estimates than perceptions of risk, which subjects the results to some uncertainty, the proportion of pooled estimates with  $n > 2$  contributing estimates is larger than both risk or social costs. Tentatively, IDs seem to have the strongest and most robust association with perceptions of rewards. This is an important point as the criminological literature has traditionally focused on perceptions of risk as a focal point of deterrence research. The results herein, however tentative, suggest that perceptions of reward may be an equally important focal point.

### ***Moderation***

The moderation analyses revealed only one significant result. The association between IDs and perceptions of reward were significantly stronger among a general population sample relative to adolescents. Specifically, this finding suggests that among older populations there is a stronger association of IDs with perceptions of reward. One potential explanation is that with age only some individuals experience a reduction in their perceptions of the rewards of offending. Those with IDs conducive to offending would retain a stronger association with the rewards of offending. Therefore, with age the covariation between IDs and perceptions of rewards of offending become stronger due to the waning association of those with low IDs conducive to offending. Additionally, research has suggested that adolescents are more reward oriented than

older age groups (Braams et al., 2015; Galvan, 2010). An adolescent sample might exhibit relatively higher and potentially more homogeneous reward orientation. Thus, when compared to a general sample, the relationship between IDs and rewards may be obscured by the nature of the relationship between adolescence and reward orientation. This pattern contrasts with perceptions of risk, which exhibited a decreased association with IDs as the age of the samples increased. Without further research on the topic, however, it is challenging to distill the substantive meaning of this relationship, especially given the limited number of estimates that constituted the perceptions of reward associations.

#### **A note on confidence**

A meta-analysis relies on the empirical data from the literature to generate estimates. The generated estimates include an associated confidence interval. The confidence interval reflects the uncertainty surrounding a derived estimate and represents a range within which the estimate can reasonably be expected to fall. It is important to keep in mind how confidence intervals are produced when discussing results from a meta-analysis. Specifically, the confidence intervals are derived from the size of the studies associated with each estimate and the variation between estimates. If estimates were derived from small studies, are heterogeneous, or are few (e.g., two estimates or less), then their confidence intervals will increase relative to many homogeneous estimates derived from large samples.

The current project assessed a broad range of IDs and their association with three PCC (perceptions of risk, social costs, and reward). The inclusion of a broad array of IDs increases the ability of the current project to speak to the association of individual differences more completely relative to using only more common IDs to make an inference. Although this increases the confidence in the overall statement that IDs are associated with PCC, some of the estimates produced large confidence intervals. These pooled estimates were typically either derived from a few underlying estimates ( $n < 3$ ), consisted of estimates with large differences in

magnitude or direction, or were associated with large standard errors (i.e., derived from studies with small samples). It is evident that most of the pooled estimates derived from one or two constituent estimates are not significant. Pooled estimates from more than three constituent estimates, however, are mostly significant with the exception of pooled estimates that contain underlying estimates with large differences (see the bivariate pooled estimate negative affect and perceptions of risk as an example). Future studies that increase the constituent estimate size ( $k$ ) for an individual difference would help in narrowing that confidence interval to get more precise estimates of the associations. For now, it seems that morality, psychopathy, and peers are three factors that suggest large effects, but with wide confidence intervals that preclude drawing any inferences.

#### **A note on variable measurement**

Meta-analysis can have several goals. Of these, differences in measurement and how they affect estimates is one. Specifically, meta-analyses can test whether differences in the operationalization of the variables have a significant impact on the results. The current project did not assess how differences in operationalization of IDs or perceptual deterrence influenced the results for two primary reasons. First, the current project included a broad range of IDs across three main outcomes of interest. In a meta-analysis, often the predictors or outcomes are each one concept (e.g., peer influence on offending). The broad range of both IDs and associated perceptions of offending included herein would create a large combination of results that may be difficult to interpret. Second, and relatedly, given the broad assortment of IDs and PCC variables, the pooled estimates for any one concept are relatively small, limiting further assessment of the variation within them. Specifically, other than a few variables (e.g., self-control and gender), there is an insufficient amount of constituent estimates to support moderation analyses of their operationalization. As more assessments of the association between IDs and perceptual deterrence emerge, estimating the differential effects that operationalization

can have will likely lead to more nuanced findings, with the IDs that showed the most variation across estimates (e.g., negative affect, morality, and fear).

### **From the perspective of individual differences**

The broad array of IDs, twelve in total, included in the models revealed several patterns. First, gender and self-control were the IDs that exhibited a significant association across almost all PCC in the multivariable models. Being significant even after accounting for covariates suggest that these IDs have a robust association with PCC. A more in-depth examination of the associations, however, suggest that self-control had a relatively weak association that was bolstered by the large number of estimates (multivariable association with risk  $z(r) = 0.0626$ ; social costs = 0.0445; reward = 0.2100) while gender had relatively stronger associations ( $z(r) = 0.0954$ ; social costs = 0.0773; reward = 0.1408). Morality, although not significant across many models, exhibited strong associations with each PCC. The non-significance is partially attributable to the lack of estimates ( $n \leq 3$ ) in 4 of the six models. Both psychopathy and peers exhibited consistent estimates of  $z(r) > 0$ , however, the estimates varied in magnitude and were frequently non-significant. Emotions (i.e., negative and positive affect, fear, and anger) exhibited inconsistent estimates with large variation and were often non-significant, which is at least due to having few estimates. Thus, from these findings, three themes emerged that should guide future research. First, some variables were found to be consistently associated with PCC and should be included in future analyses of PCC and other outcomes. These variables included self-control, sex/gender, peers, and morality. Second, some variables suggested an association that was not substantiated due to few estimates. These variables included executive function and psychopathy. And third, some IDs were inconsistent but showed promise. These variables exhibited strong but varying estimates suggesting that methodological variation may account for some of the inconsistencies. These IDs—typically emotions—were perhaps the most interesting as they could vary depending on sample composition, study design, or other factors which were

not included in the current project. These factors are not amenable to testing given the lack of estimates to adequately conduct subgroup moderation analyses. Nevertheless, the current project yielded results that have potential to contribute to research, treatment, and policy as discussed below.

### **Research, Treatment, and Policy**

The purpose of the current project was to assess the association of elements of developmental criminology with situational theories of offending. More precisely, the current project sought to assess how an array of IDs are related to PPC. In assessing these associations, the current project adds to the literature in developmental criminology by identifying potential mechanisms for developmental antecedents to influence outcomes through proximal factors. For example, the influence of self-control on offending could be indirect through PCC (Altikriti, 2021). Integrating these often-isolated perspectives of offending contributes to research, treatment, and policy.

#### **Research**

The overall findings that IDs were associated with perceptions of risk, social costs, and rewards is not unexpected given the recent research providing evidence in support of this association (Altikriti, 2021; Carmichael & Piquero, 2004; Hirtenlehner, 2019; Pickett et al., 2018; Pickett & Bushway, 2015; van Gelder & de Vries, 2012). The current project aimed to meta-analyze this literature to put these studies in perspective regarding an overall estimate, the IDs that appear most frequently (and those that suggest an association but have few estimates to substantiate it), and sample characteristics that might influence these findings. The findings suggested an association between IDs and all three PCC. These association provide empirical evidence to the effort to merge IDs with more proximal antecedents of offending (e.g., situation characteristics). In their assessment of the association between deterrence and offending outcomes, Pratt et al. (2006) stated that for deterrence theory to remain relevant to mainstream

criminology, scholars “should continue... assessing how individual differences and situational characteristics influence certainty and severity perceptions” (pg. 382). The current project is an assessment of that literature and a jumping off point for future research on the topic. Specifically, future research must contend with the interrelated nature of IDs and PCC, where these elements had been traditionally seen as opposing explanations of offending. Additionally, the robust associations exhibited with pooled estimates derived from  $n > 3$  estimates suggest that future research may be misspecified if IDs are not included as covariates in assessing perceptual deterrence and offending. These results corroborate previous research that aimed to differentiate individuals regarding their deterrability (Jacobs, 2010; Pogarsky, 2002).

As outlined previously, rationality in the current project is conceptualized as the extent that individuals objectively perceived the risks and rewards of offending given limited information. To the extent that IDs systematically skew PCC, an individual is considered irrational as their PCC are based not only on available information but on IDs. The results of the analyses in the current project suggested that individuals are, generally, not entirely rational. Specifically, the results suggested that certain IDs systematically influence PCC. These individuals who have a heightened risk of offending due to IDs subsequently have a heightened risk of offending due in part to their PCC. In other words, their IDs influence their PCC, where both increase the risk of offending. These risk factors may also interact to influence offending outcomes, although this question is beyond the scope of the current project. In light of the findings herein, future research should be careful to (1) acknowledge the potential bias (i.e., irrationality) of offender decision making, (2) include aspects of IDs in assessing the effects of PCC on offending or include PCC when assessing the effects of IDs on offending, and (3) consider the moderating effect that PCC may have on the relationship between IDs and offending.

## **Treatment**

The current criminal justice system focuses primarily on deterrence and rehabilitation/treatment efforts. Both these objectives tend to emphasize contemporaneous factors and neglect developmental antecedents. For example, deterrence policies are intended to discourage offending choices through a blanket policy based on the threat of sanction and treatment policies often focus on current risk-factors such as thinking patterns, drug use, and employment. Addressing contemporaneous risk-factors such as PCC, however, may be more beneficial when done in combination of addressing latent factors or IDs, especially given research suggesting that contemporaneous factors are at least partially stemming from distal developmental factors. The current justice system should take this into account when designing treatment for justice-involved individuals. This is especially pertinent given the results suggesting that age significantly moderates the relationship between IDs and PCC. The moderation analyses that suggested an attenuation of the association over time suggest that it is more important to address that link among at-risk juveniles who exhibited a stronger association with reduced perceptions of risk. Importantly, however, none of the moderation analyses suggested that samples of individuals who had criminal justice system involvement had significantly different associations between IDs and PCC. These findings suggest that justice-involved individuals do not have stronger or weaker PCC due to their IDs. Thus, broad policies can be used to influence PCC rather than targeting specific populations.

Regarding IDs, developmental criminologists often advocate early intervention in preventing delinquency and long-term patterns of offending (e.g., Gottfredson & Hirschi, 1990; Moffitt, 1993). The current project supports this suggestion with the findings exhibiting that IDs can influence contemporaneous PCC. Beyond early intervention, identifying the antecedent latent traits associated with PCC can aid in individualized treatment, improving receptivity. Early intervention, however, is difficult to target given that most children who display early risk factors



assimilate well as adults (Moffitt, 1993; Robins, 1978). Thus, the causes of offending are a product of several distal and proximal factors and treatment policy must reflect that. Within these policies, the mediating mechanisms between IDs and offending provide an avenue for a developmentally informed justice system. For example, an approach could include self-control training along with cognitive behavioral therapy focused on the risk of offending to address both risk factors assessed in the current study.

### **Policy Implications**

Albeit cautiously, the current project informs broader policy on the current operations of the criminal justice system. Specifically, the results from the current project suggest that variation in PCC is at least partially due to variation in IDs, where certain IDs can predispose some to undervalue the risk inherent in offending. Thus, a system intended to deter offending through the threat of sanction certainty or informal sanctions may be ineffective for individuals whose IDs predispose them to reduced PCC. Therefore, although deterrence policies suggest a modest overall effect on reduced offending (see Pratt et al., 2006), the current project maintains that these effects may vary across individuals. Subsequently, the effect of deterrence in reducing offending may be the least effective for those most at risk as they underestimate deterrent effects. The results herein challenge the fundamental assumption of the current criminal justice system with evidence that punishment-oriented policies may be the least effective for the most at-risk of individuals (see Jacobs, 2010). For example, the results suggested that those with reduced self-control (an already at-risk population) are also more likely to have increased PCC. Therefore, the results challenge specific policies that aimed to deter chronic offenders through severe punishment threat (e.g., three-strikes laws) which may be least effective for the target population they are intended to influence (i.e., those with IDs that predispose them to risk). Therefore, the current project supports policies that address antecedent factors along with concurrent PCC. Programs such as Thinking for a Change and Moral Recognition Therapy have shown evidence

of addressing concurrent PCC (Landenberger & Lipsey, 2005). These programs, in conjunction with programs that exhibit evidence of increasing self-control for adjudicated youth (see Hay et al., 2018), address both risk factors of IDs and PCC.

### ***Perceptions of Reward and the Adolescent Brain***

For most individuals risk seeking and delinquency peaks during adolescence (Gottfredson & Hirschi, 1990; Moffitt, 1993; Steinberg et al., 2008). Neuroscience research supports this claim, suggesting that the neurological underpinnings of risk taking and self-control develop over time, with the adolescent brain being highly reward-oriented and risk-seeking (Braams et al., 2015; Meldrum et al., 2018). The current projects extended this research with results suggesting that IDs have the least impact on perceptions of reward in adolescent samples relative to college students and the general population. Although assessing the mechanisms that account for this pattern is beyond the scope of the current project, one plausible explanation is that homogeneity in perceptions of reward during adolescence, where individuals are reward-driven, diminishes the variation that can be accounted for by IDs. This explanation reconciles the results with literature on the development of perceptions of reward. As individuals age, however, perceptions of reward may develop differentially across individuals. Thus, as perceptions of reward develop over time, IDs can account for more variation.

The moderation analyses revealed that adolescents are relatively more uniformly susceptible to the “pull” of delinquency and other risky activities due to their perceived rewards. Therefore, with research suggesting that perceptions of reward influence offending (Altikriti, 2021; Nagin & Paternoster, 1993; Piquero & Tibbetts, 1996), potential policy implications should be directed broadly toward adolescents rather than targeted to those at risk. Specifically, policies aimed at providing activities to satisfy reward-oriented youths without the risk of delinquent behavior should be widespread and readily accessible as an alternative to risky behavior. For example, partnerships between communities and local wildlife or adventure parks

(e.g., Six Flags) may offer stimulating activities that satisfy the thrill-seeking component of adolescence without the associated risk of delinquency. A more common approach is to provide structured and semi-structured activities for adolescence. Accessibility to sports and clubs in schools and the community may satisfy reward-oriented youths within a safe and monitored environment (Cameron & MacDougall, 2000).

### ***Perceptions of Risk and the Lived Experience***

Unlike perceptions of reward, perceptions of risk exhibited a stronger association between IDs among adolescent samples relative to general samples. This pattern suggests that there is more heterogeneity in perceptions of risk accounted for by IDs during adolescence than later in the life course, where IDs mattered less in determining the perceived risks of offending. Thus, perceived risk either becomes a random process, is determined by alternative predictors (i.e., not IDs), or becomes more uniform. Again, although assessing the mechanism that accounts for this pattern is beyond the scope of the current project, a potential explanation is offered that reconciles the latter two explanations. Experience with offending and arrest can update perceptions of risk (Anwar & Loughran, 2011) and potentially create more uniform and accurate perceptions. As individuals age, their lived experience provides more information with which to adjust their perceptions of offending risk. Thus, along with age, experience becomes an important determinant of perceptions of risk.

Programs such as cognitive behavioral therapy or educational programs on the consequences of risky behavior serve the function of informing individuals about risk. These programs may have a delayed effect as information is absorbed and assimilated. As individuals age and new information informs risk, individuals begin to adjust their perceptions. This pattern is evident in studies of the Drug Abuse Resistance Education program. Specifically, research has suggested no immediate beneficial effects of the program; however, delayed or sleeper effects were found in follow-up studies (Dukes et al., 1997). Thus, a potential policy implication is

diversion programs for arrested youths and educational programming to adequately develop appropriate awareness of the risks of offending.

### ***Deterrence Over the Life-Course***

Rational choice and deterrence theories take a situational view on preventing offending. The current project, however, suggests that integrating elements of life-course and developmental theories expands the potential policy recommendations of deterrence theory without reliance on punitive measures. As discussed in the previous section, perceptions of risk seem to align over time where IDs have less of an influence as individuals age and perceptions of risk develop through experience. Therefore, youth education on the risks of offending, especially for at-risk youths, may prove beneficial as an alternative to formal judicial processing which is often accompanied by negative experiences, especially for those with reduced social capital (Anderson et al., 2020). This approach complements the results on perceptions of reward. Specifically, diverting individuals from the criminal justice system and offering educational services addresses perceptions of risk while diverting individuals allows them time to become less reward driven. Overall, the results herein suggest that informing risk perceptions during adolescence while occupying their free time through reward-oriented activities addresses both elements of deterrence for youths. These policies may reduce offending while minimizing the use of official sanctions.

### **Limitations**

The current project has seven main limitations. First, there was a lack of estimates to adequately assess the granular relationships between any given ID and any given PCC. Specifically, some individual difference with pooled estimates of  $n < 3$  exhibited relatively strong effects but were not significant due to their confidence intervals. This limitation also extends to the moderation analyses intended to contextualize the estimates within certain study and sample characteristics. The second limitation is that the current project did not include

measures for different operationalizations of specific IDs. Although most IDs with  $n > 3$  estimates suggested congruence in their estimates (i.e., estimates did not vary excessively), assessing the effects of operationalization would have been beneficial for future research. Third, the results herein are an aggregate of previous research (i.e., the sample estimates). Although a meta-analysis adjusts for any particular weakness of an individual study or estimate, if there are systematic issues or biases (e.g., publication bias) that affect a sizable number of derived estimates, then the results herein would also be inaccurate. Thus, the results herein are only as reliable as the sample from which they were gleaned. To mitigate some of these concerns, several robustness checks were implemented, including funnel plots, Egger's test of asymmetry, and  $p$ -curve analyses. Fourth, concerns about sample size also extend to the general analyses. In a sample of 22 studies, outliers may have an exaggerated effect on the analyses. Transforming the estimates to Fisher's  $z$  scores may exacerbate these concerns. The derived 178 estimates buffered some of these concerns about sample size since many studies contributed multiple estimates.

Fifth, the current project focused on the formation of PCC (i.e., the influence/association of IDs on PCC), whether this relationship affects future behavior is still unclear. Studies that have conducted moderation analyses using IDs and PCC to predict offending can address this limitation. These studies, however, are not within the scope of the current project. Sixth, the current project assessed the association between IDs and PCC, without criteria to assess directionality. However, because IDs are generally viewed as relatively stable, it is more likely that IDs influence PCC rather than the opposite. Although the longitudinal estimates and measures for experiential effects in the analyses support the temporal order of the influence of IDs on the formation of PCC, causality cannot be established. Seventh, the results herein are confined within the parameters of the constituent studies from the literature. Specifically, estimates from the literature on the relationship between IDs and PCC were derived from either

bivariate or multivariable models. Assessing directionality and potential causality is an important consideration for future research. This assessment, however, is beyond the scope of the current project. Assessments of within-individual change in IDs and PCC could potentially shed light on to the mechanisms underlying the relationships assessed in the current project.

## **Chapter 7: Conclusion**

The current project subjected the literature on the association between individual differences and perceptual deterrence to a meta-analysis. Assessing this link is important in reconciling the distinct perspectives of developmental criminology and situational theories of crime. Where developmental criminology often views offending behavior as a longitudinal process years in the making, situational theories focus on the most proximal factors that influence an offending decision. Merging these perspectives offers a potentially more complete view of the etiology of offending and addresses the shortfalls from each perspective using the strengths of the other. The current project finds strong evidence for the compatibility and empirical association between a range of individual differences and perceptions of risk and reward. In other words, IDs that are associated with offending outcomes (e.g., self-control, deviant peers, and sex) also exhibited empirical associations with perceptions of risk, social costs, and reward. Most of these associations were in the theoretically expected direction, suggesting these theories can be integrated to better predict and address risk factors for offending behavior.

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## Appendix

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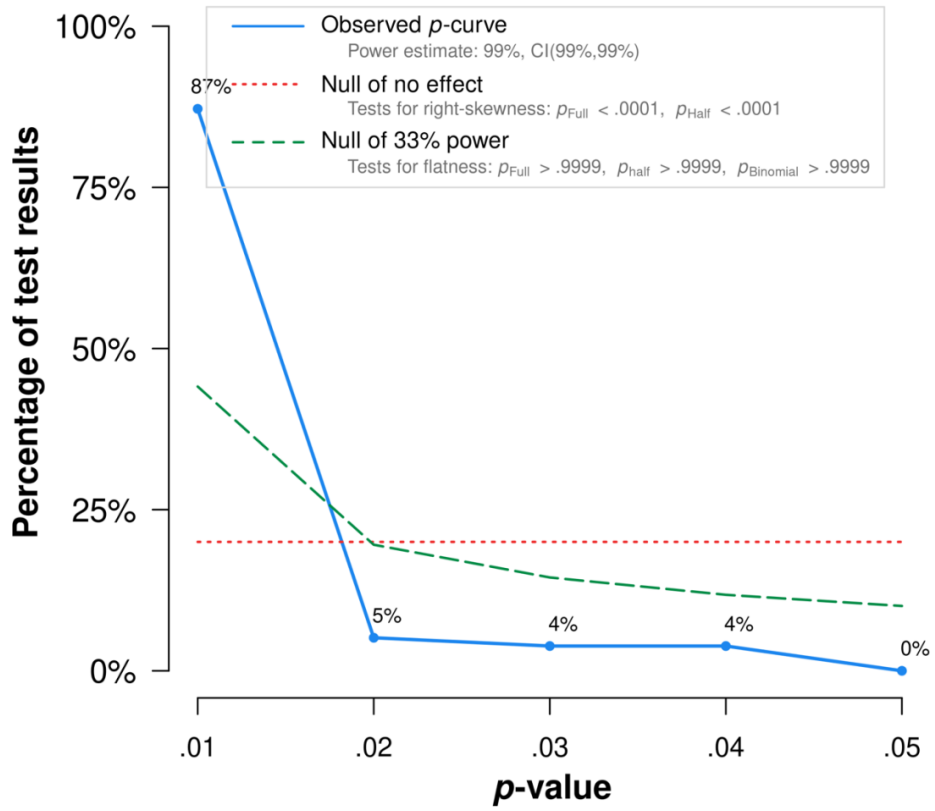
Table A1: Detailed summary of the studies included in the meta-analysis.

Author(s)	Year of publication	Sample Frame	Offending Sample	Sample Size	Independent Variable	Dependent Variable	Experimental Effects	Analysis
(Altkriti, 2021)	2020	Adolescents	Yes	1170	Executive Function; Morality; Self-control	Risk; Social Costs; Rewards	Yes	Multivariable
(Altkriti & Nedelec, 2020)	2020	Adolescents	Yes	987	Gender; Peers; Psychopathy; Self-control	Risk; Social Costs; Rewards	Yes	Bivariate; Multivariable
(Bouffard, 2015)	2015	Population	Yes	1013	Fear; Anger	Risk	No	Bivariate
(Carmichael & Piquero, 2004)	2004	College	No	382	Anger; Gender; Morality; Self-control	Risk; Social Costs; Rewards	No	Multivariable
(Hirtenlehner, 2019)	2019	Adolescents	No	716	Gender; Morality; Peers; Self-control	Risk	No	Bivariate; Multivariable
(Hirtenlehner & Hardie, 2016)	2016	Adolescents	No	2911	Morality; Peers; Self-control	Risk	No	Bivariate
(Hirtenlehner et al., 2014)	2014	Adolescents	No	2911; 1224; 409	Gender; Self-control	Risk	No	Bivariate
(Kamerdze et al., 2014)	2014	College	No	298	Positive affect; Negative affect; Self-control	Risk	No	Bivariate
(Lanza-Kaduce, 1988)	1988	College	No	139	Morality	Risk	No	Bivariate
(Neissl et al., 2019)	2019	Population	No	1414	Gender; Peers	Risk; Social Costs; Rewards	Yes	Bivariate
(Patemoster et al., 1983)	1983	College	No	300	Gender; Morality	Risk; Social Costs	Yes	Bivariate; Multivariable
(Pickett et al., 2018)	2018	Population	No	965	Gender; Peers; Self-control	Risk	No	Multivariable
(Pickett & Bushway, 2015)	2015	Population	No	878; 496	Gender; Negative affect; Peers; Positive affect; Self-control	Risk	Yes	Multivariable

(Piquero et al., 2016)	2016	Population	Yes	1013	Morality	Risk	No	Bivariate
(Pogarsky & Piquero, 2002)	2002	College	No	250	Gender; Self-control	Risk	No	Bivariate
(Tibbetts & Piquero, 1999)	1993	College	No	604	Morality; Self-control	Risk; Social Costs; Rewards	No	Bivariate
(Rebellion et al., 2010)	2010	College	No	439	Gender; Peers; Self-control	Risk; Social Costs	No	Bivariate; Multivariable
(Scheepers & Reinecke, 2018)	2018	Adolescents	No	2180; 1005	Morality; Peers; Self-control	Risk	No	Bivariate
(Svensson, 2015)	2015	Adolescents	No	891	Gender; Morality; Self-control	Risk	No	Bivariate
(van Gelder & de Vries, 2012)	2012	Population	No	716	Emotionality; Negative affect; Self-control	Risk	No	Bivariate; Multivariable
(van Gelder & de Vries, 2016)	2016	Population	No	590	Emotionality; Gender	Risk	No	Bivariate
(van Gelder & de Vries, 2014)	2014	College	No	153; 129	Emotionality; Conscientiousness; Negative affect; Self-control	Risk	No	Bivariate

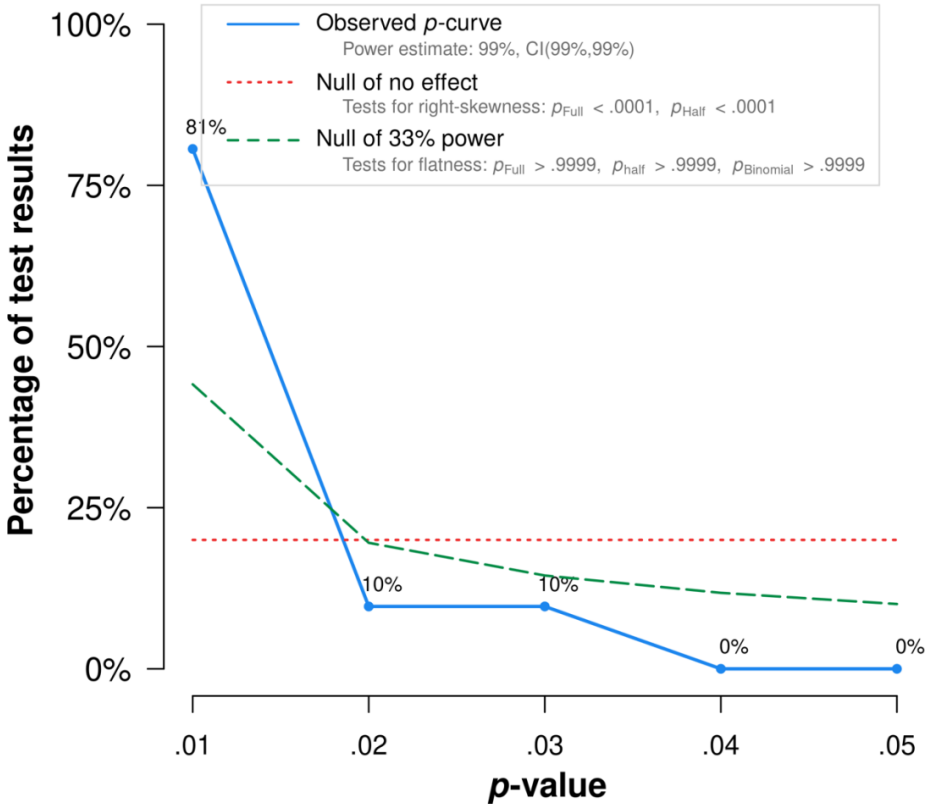
*Note:* A study (Cihan & Tittle, 2019) was excluded due to the difficulty of interpretation in the results and two estimates were excluded from another (Patemoster et al., 1983) due to potential anomalies discussed in the Results section.

Figure A1: *P*-curve analysis of the significant associations ( $r[df]$ ) between individual differences and perceptions of risk.



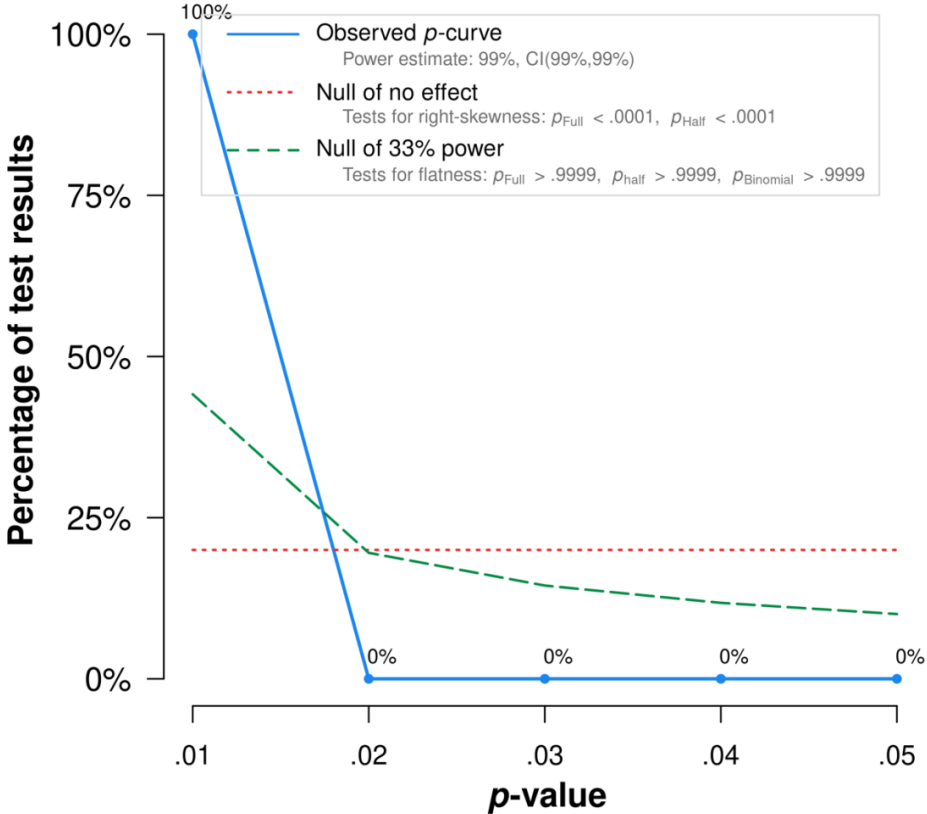
Note: The observed *p*-curve includes 78 statistically significant ( $p < .05$ ) results, of which 73 are  $p < .025$ . There were 35 additional results entered but excluded from *p*-curve because they were  $p > .05$ .

Figure A2: *P*-curve analysis of the significant associations ( $r[df]$ ) between individual differences and perceptions of social costs.



Note: The observed *p*-curve includes 31 statistically significant ( $p < .05$ ) results, of which 31 are  $p < .025$ . There were 11 additional results entered but excluded from *p*-curve because they were  $p > .05$ .

Figure A3: *P*-curve analysis of the significant associations ( $r[df]$ ) between individual differences and perceptions of reward.



Note: The observed *p*-curve includes 33 statistically significant ( $p < .05$ ) results, of which 33 are  $p < .025$ . There were 2 additional results entered but excluded from *p*-curve because they were  $p > .05$ .