Integrating States, Traits, and a Dual-process Approach with Criminal Decision-making Literature: Theoretical and Methodological Advancements

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Preface

Declaration

This thesis is submitted for the degree of Doctor of Philosophy. This thesis is a result of my own work and includes nothing which is the outcome of work done in collaboration except as declared in the preface and specified in the text. It is not substantially the same as any work that I have already submitted nor is being concurrently submitted to any degree or other qualification at the University of Cambridge or any other university or similar institutions expect as declared in the preface and specified in the text. This thesis is 56,451 words in total (exclusive of: In-text Tables, References, and Appendices) and does not exceed the prescribed word limit of 60,00 for the School of Biological Sciences degree committee.

Publications and Conferences Derived from this Thesis

Chapter Two

McClanahan, W.P., van der Linden, S., & Ruggeri, K. (2019). Decision-making style mediates the relationship between trait self-control and self-reported criminal behavior. *Personality and Individual Differences, 151 (*2019*)*, 109537.

Conference Presentation – SPSP, 2020

Chapter Three

McClanahan, W.P., van der Linden, S. (2020). An uncalculated risk: Ego-depletion reduces the influence of perceived risk but not state affect on criminal choice. *Psychology, Law, and Crime*. DOI:10.1080/1068316X.2020.1837129

Publications Arising from Work Unrelated to this Thesis

Roozenbeek, J., Maertens, R., **McClanahan, W.P.,** & van der Linden, S. (2020). Disentangling item and testing effects in inoculation research on online misinformation: Solomon revisited. *Education and Psychological Measurement*. https://doi.org/10.1177/0013164420940378

Saleh, N., Roozenbeek, J., Makki, F., **McClanahan, W.P.,** & van der Linden, S. (2021). Active inoculation boosts resistance against extremist persuasion techniques – A novel approach towards the prevention of violent extremism. *Behavioural Public Policy*, 1-24. doi:10.1017/bpp.2020.60

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Abstract

When assessing what factors promote or deter criminal behavior, theories have primarily focused on: 1) distal, individual differences or 2) proximal, decision-making factors about perceived costs and benefits. By remaining independent, each approach limits its explanatory power. Methodologically, one of the primary ways of assessing criminal decision-making in the psychological literature is the written vignette approach. However, hypothetical scenarios may not accurately represent the circumstances under which people make real-life decisions, creating a potential intention-behavior gap. Furthermore, researchers tend to use closed-ended questions that assess factors that are deemed relevant to criminal decision-making, rather than allowing participants to naturally recall factors they themselves deemed important to their decision-making. Collectively, these limitations reduce the ecological validity of theories derived from such studies. Through a series of observational and experimental studies, this doctoral thesis advances the literature by integrating psychological and criminological theory. I align proximal with dual-process decision-making perspectives by including determinants such as emotions and norms and combine it with important individual differences. This thesis also offers novel methodological advancements by contrasting vignettes against immersive virtual reality and closed vs. open-ended responses.

Using a large-scale survey, I first established a relationship between trait self-control, a dual-process model of decision-making, and criminal behavior. The results of which indicated that intuitive decision-making (traditionally unmodelled) is associated with criminal behavior (Chapter Two; McClanahan et al., 2019). Secondly, using a standard experimental ego-depletion task, I sought to examine how state self-control directly and indirectly influenced criminal behavior. Although participants were successfully depleted, there was no main effect of ego-depletion on criminal behavior. However, while perceived risk, a central tenant of the rational model, predicted criminal behavior for non-depleted participants, it did not predict criminal behavior for depleted participants (Chapter Three; McClanahan & van der Linden, 2020). Finally in a series of studies comparing virtual reality and video presentation of a vignette to traditional written methods, I examined how immersion, rather than imagination, influenced criminal behavior when self-control was depleted and what factors individuals

naturally consider when making decisions around criminal behavior. Replicating the findings of Chapter Three, compared to control groups, depleted participants were no more likely to indicate criminal behavior when using virtual reality (Chapter Four), nor was there a difference in criminal behavior when compared to the traditional written method (Chapter Four) or videos (Chapter Five). Participants that either saw a video or experienced the vignette in virtual reality indicated a significantly greater subjective presence than participants that read the same vignette (Chapter Four and Five). Additionally, while participants naturally consider factors that align with traditional proximal theories (e.g., getting arrested), they also naturally consider a number of factors that do not fit within such a perspective, such as state affect and norms which were better predictors of criminal behavior (Chapter Five). Theoretical and methodological implications for research and policy are discussed.

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Abbreviations

95% CI – 95% Confidence Interval

AUC – Area Under the Curve

CFA – Confirmatory Factor Analysis

CFI – Comparative Fit Index

HMD – Head Mounted Display

OR – Odds Ratio

RCT – Rational Choice Theory

RMSEA – Root Mean Square Error of Approximation

SAT – Situational Action Theory

SDB – Social Desirability Bias

SEM – Structural Equation Modeling

SRCB – Self Reported Criminal Behavior

SRMR – Standardized Root Mean Squared Residual

TLI – Tucker-Lewis Index

VIF – Variance Inflation Factor

VR – Virtual Reality

Chapter 1: Introduction

"Everybody has been touched by crime and everybody wants to know why this is so" (Bonta & Andrews, 2016, p. 1).

While various criminological theories addressing the question of why an individual would commit a crime exist, they have largely progressed on two distinct paths (Nagin & Paternoster, 1994). One perspective, commonly referred to as the *proximal* theory or perspective, focuses on criminal behavior in relation to the immediate context and overall environment nearer to the moment of decision-making. Conversely, the other set of theories is referred to as the *distal* perspective and examines either a single or set of characteristics that determines individuals' criminal propensities, which in turn either promote or deter criminal behavior across time and situations.

While both perspectives have found empirical support, they are historically tested in isolation leaving questions or gaps in the proposed model and reducing their overall explanatory power (Nagin & Paternoster, 1994).[1] Distal perspectives often fail to explain how homogeneity in criminal propensities results in a high degree of variation in criminal behavior. That is, why individuals with similar characteristics that are thought to predict or associate with criminal behavior do not offend at similar rates (Van Gelder & De Vries, 2014) nor do they offer an explanation of how these dispositions lead to criminal behavior (e.g., mediated or directly; Dodge & Pettit, 2003). For example, the General Personality and Cognitive Social Learning theory states that the eight criminogenic factors alongside the immediate situation influences "rewards/costs favorable to crime: decision to act" (Bonta & Andrews, 2016, p. 44), but does not explain the decision-making process itself. Traditional proximal models do not consider how individual differences may influence the decision-making process and thus the perception of costs and benefits (Pratt, Cullen, Blevins, Daigle, & Madensen, 2017) and make no accommodation for the prevalent distal theories that continually find support (e.g., Bonta & Andrews, 2016).

As each framework takes a different perspective on what causes criminal behavior, they also differ in the type of policies or programs designed to reduce criminal behavior (Nagin & Paternoster, 1994). The distal perspective suggests that long-standing individual differences

[1]Theories from the distal perspective do *not* believe that proximal factors are irrelevant to criminal behavior, nor vice versa, but both perspectives simply isolate and focus on one aspect or the other.

should be targeted and treated to reduce criminal behavior. For example, the program, "Becoming a Man", uses various Cognitive Behavioral Therapy techniques to change how at-risk youth in the Chicago area make decisions. Specifically, this program emphasizes the importance of slowing down and not automatically reacting in situations (Heller et al., 2016). The program reduces arrests and violent crimes as well as increases school engagement. The program has a modest to large cost-benefit ratio (5:1 or 30:1 depending on the outcome variable). Conversely, the proximal perspective emphasizes the need to address the immediate situation and social surroundings of the individual to reduce criminal behavior. For example, citing theories such as Routine Activity Theory (Cohen & Felson, 1979) and Broken Windows Theory (Wilson & Kelling, 1982)[2] as a driving force of criminal behavior, there is a growing amount of literature showing that changing the physical environment in high crime areas (e.g., repairing buildings, cleaning vacant lots, and creating more green spaces) reduces criminal behavior (e.g., Kondo et al., 2018; MacDonald et al., 2019; Moyer et al., 2019). Thus, while each perspective offers a piece of the puzzle with different policy approaches and implications, the full picture remains incomplete. This may result in policies that only tackle a small portion of the variance in criminal behavior or policies that counteract one another.

Researchers have sought to reconcile these limitations by combining both perspectives. Notably, using hypothetical scenarios (*vignettes*), Nagin and Paternoster (1993) observed that both trait levels of self-control (a long-standing distal correlate of criminal behavior; Pratt & Cullen, 2000) and traditional deterrence variables such as the likelihood of apprehension, uniquely predicted criminal behavior. That is, when controlling for the unique influences of both distal and proximal variables, each still influenced criminal behavior, thus highlighting the importance of both. Best stated:

> …while poor self-control plays a major role in explaining the variation in intentions to offend, it is by no means the sole determinant of such intentions. Perceived risks and rewards play comparably important roles.
>
> (Nagin & Paternoster, 1993, p.486)

Although integrating these two criminological approaches is an important first step to better understanding criminal behavior, to most accurately represent human decision-making

[2]Such theories take a proximal approach and propose a motivated offender recognizing a criminal opportunity by noticing cues in the environment that highlight the likelihood of success or failure of committing a crime (e.g., the presence or absence of witnesses).

it is critical to examine these criminological theories in relation to decision-making literature derived from psychology and behavioral science.

Rational Choice Theory and the Deterrence Perspective

Cesare Beccaria (1986, originally published in 1764) set the foundations for traditional theories of criminal decision-making such as Rational Choice Theory (RCT), the deterrence model (e.g., Becker, 1968; Cornish & Clarke, 1986), as well as the modern penal system more generally (Pratt, Gau, & Franklin, 2011). Such theories propose a singular decision-making process in which all outcomes are weighed against one another with the outcome yielding the greatest gain (or least amount of loss) being chosen. Historically (e.g., Beccaria, 1986), costs associated with criminal behavior have been modelled as formal, such as the certainty of apprehension by official actors (e.g., law enforcement) and the severity of the resulting punishment. Since then, such theories have expanded to account for the fact that humans act within bounded rationality using incomplete information and subjective weighing of outcomes (Savage, 1954; Zimring, 1973). That is, models now account for the fact that risks and benefits are not objectively viewed and can vary between individuals or within an individual over time.

Additionally, such models have gone on to include informal costs and benefits (e.g., job loss or status gain), as well as how formal costs may give rise to informal costs (Anderson et al., 1977; Nagin, 1998). For example, an individual could get arrested (a formal cost) and ultimately lose their job (an informal cost). In sum, the RCT and deterrence perspective have focused largely on a rational, cognitive, decision-making process that subjectively weighs the formal and informal costs and benefits in each situation. Through this decision-making process it is theorized that individuals will choose the alternative with the greatest benefit or the least amount of cost. This decision-making process may be rudimentary and imperfect; however, what is clearly suggested is some form of reasoning between pros and cons before exhibiting a behavior.

Pragmatic Limitations

As indicated above, the RCT perspective was not designed to perfectly describe all aspects of human decision-making, but was designed to be pragmatic in regards to developing an efficient justice system by describing core elements of decision-making that are amendable

through policy interventions (e.g., Clarke, 2013; Pratt et al., 2011). However, when considering the psychology of punishment and the greater empirical literature, the pragmatism of a model that only describes a portion of decision-making may be limited.

Using macro-level analyses,[3] a meta-analysis (K = 214; Pratt and Cullen 2005) compared the predictive effects of various theories using variables indicative of social structure, socioeconomic status, and criminal justice aspects. The latter set were proxies for a deterrence perspective while the former two were proxies for other social-based macro theories (e.g., Cohen & Felson, 1979; Merton, 1938; Shaw & McKay, 1929). Justice aspects included variables such as police force size, police force expenditure, arrest rate, police per capita, get-tough policies, mandatory sentencing laws, and the death penalty. From an RCT perspective, such aspects should be negatively related to criminal behavior and be a greater predictor of crime rates when compared to social structure factors (e.g., standard demographics, firearm ownership, racial heterogeneity, residential mobility, family structure/disruption, and unsupervised local peers) and socioeconomic variables (e.g., poverty, unemployment, and inequality).

However, the meta-analysis (Pratt & Cullen, 2005) returned weak support for the deterrence variables. Specifically, the top five predictors of crime rate included: three social structure variables (the strength of noneconomic institutions, firearm ownership, and percentage nonwhite), one socioeconomic status variable (unemployment), and one criminal justice variable (incarceration rate). Specifically, the strength of noneconomic institutions and incarceration rates were negatively related to the crime rate, with the former being greater in magnitude than the latter.[4] Unemployment, firearm ownership, and percentage nonwhite were all positively related to the crime rate. The bottom five predictors included a single social structure variable (education effects) but four criminal justice variables (police expenditures, get-tough policies, police per capita, and police force size). The bottom predictors all had negligible effect sizes of 0.10 or less while the top five had moderate effect sizes of 0.30 or

[3]Macro-level studies compare geographic regions (e.g., census tracts or states) using their respective justice policies (e.g., presence of 'get tough on crime' policies) and population characteristics (e.g., poverty or racial heterogeneity) as predictors of variation in their respective crime rates (e.g., Cohen & Felson, 1979; Merton, 1938; Shaw & McKay, 1929; Wikström, 2004).

[4]While incarceration was a top five predictor in the expected negative direction, it is not possible to disentangle if this is due to general deterrence as suggested by deterrence theorists (i.e., the perceived likelihood of incarceration preventing behavior) or incapacitation effects (i.e., criminals are incarcerated and thus cannot commit crimes).

higher.[5] That is, get-tough policies, police per capita, and police force size had a comparatively low effect size (2 standard errors below the average effect size of all variables). Furthermore, the relative effect sizes varied drastically as a function of study design (e.g., cross-comparison versus longitudinal) and geographic region (e.g., census tract versus state). Conversely, other non-deterrence variables (e.g., social structure variables) had comparatively high effect sizes and were robust across study design and geographic region. This suggests that not only are traditional indicators of the RCT and deterrence perspective particularly weak predictors of criminal behavior, but that other social structure variables are stronger and more robust predictors.

Furthermore, the psychological literature surrounding punishment also questions the pragmatic implications of deterrence theory, primarily through the requirements of certainty. Unlike rewards in which a random reinforcement schedule maximizes effectiveness (i.e., ratio or interval reinforcement), for punishment to be effective it must occur after every iteration of undesirable behavior (e.g., criminal behavior; Akers & Sellers, 2008; Bonta & Andrews, 2016).[6] However, within the criminological literature there is a known discrepancy between the number of crimes that are made aware to official actors within the criminal justice sector and the number of crimes that actually take place, with the latter being greater. The so-called 'dark figure' (Walsh, 2011) is a clear indication that at an institutional level, not all crimes are made known and therefore not all crimes are formally punished, and in fact most may go unpunished (Hennessy et al., 1999; Langton et al., 2012). Moreover, individuals do not perceive the certainty of punishment objectively. For example, by use of experimentally manipulated hypothetical scenarios, researchers have found that as the number of people involved with a criminal action increases, the perceived likelihood of formal risk (e.g., arrest) significantly decreases (Mcgloin & Thomas, 2016). Such subjectivity compounds the issues surrounding certainty. That is, institutional limitations and individual perception undermine the certainty of punishment, thus reducing the pragmatic effectiveness of a deterrence perspective.

[5]The effect size estimate used within the meta-analysis was a standardized correlation coefficient (*r*)

[6]Although not discussed here, Bonta & Andrews (2016) also note the deterrence perspective violates the requirements of immediacy, maximum intensity, the punishment to reward ratio, and eliminating reinforced alternatives.

Theoretical Limitations

Perhaps more notable than the pragmatic limitations above are the theoretical limitations of models that only consider the cognitive dimension of decision-making, such as the RCT and deterrence perspective. For example, using the findings of theories such as Prospect Theory (Kahneman & Tversky, 1979), researches have noted several *irrationalities* (as defined by Kahneman, 2003) within criminal decision-making that fail to be accounted for by traditional RCT and deterrence perspectives (e.g., Bushway & Owens, 2013; Study 2 in Pickett, 2018).[7]

For example, there are irrationalities in criminal decision-making relating to the *likelihood* of apprehension and the *severity* of punishment if apprehended, two fundamental aspects of the RCT and deterrence perspective (e.g., Williams & Hawkins, 1986). Per such perspectives, the cost associated with criminal behavior should hold a positive linear relationship with deterrent effects. That is, as the likelihood of apprehension and/or severity of punishment increases, the deterrence effect should increase, thus decreasing the likelihood of criminal behavior.

However, the relation appears to be dichotomous. Once cost is present to a certain degree, deterrence effects do not increase further. For example, in a study assessing tax compliance in relation to perceptual costs of punishment, any non-zero probability of prosecution deterred criminal behavior (Klepper & Nagin, 1989). In other words, a greater certainty of punishment would not result in a greater subjective cost. That is, although deterrence theory suggests that increased costs (in this case probability of prosecution) should result in a greater deterrent effect, it appeared that any non-zero probability had approximately the same deterrence effect.

The reason for observing the non-linear relationship between cost and deterrence effects may be due to the principle of diminishing sensitivity and probability weighting described by Prospect Theory (Pogarsky et al., 2018). According to Prospect Theory, both the value of a

[7]Per Kahneman (2003), irrationalities are deviations from the accepted definition of rationality derived from economical models. For example, to be rational (in economic terms) people should not change their preferences because of irrelevant stimuli. However, humans will often change their preferences as a result of irrelevant stimuli such as how information is presented (i.e., The Framing Effects; Kahneman, 2003). Therefore, in this case one would be irrational. However, irrationality should *not* be considered synonymous with having intellectual deficits or a psychological disorder.

loss and a gain increase at a diminishing level, as a concave function for the former and convex function for the latter (Kahneman & Tversky, 1979). Simply stated, while the increase from zero to one and the increase from 50 to 51 are objectively one unit and thus equal, the subjective value which is derived from both are unequal, with the former having a greater merit than the latter. Therefore, in the context of risk and criminal behavior, moving from 'no risk' to 'some risk' has a deterrent effect, but moving from 'some risk' to 'some more risk' does not have *more* of a deterrent effect.

In addition to subjective value, one of the reasons for observing such a pattern may be due to how such outcomes make us feel (Rottenstreich & Hsee, 2001). Recognizing that not every outcome is affective-laden, it suggested that affective-rich outcomes give rise to fear (in the context of loss) and hope (in the context of gain). The amount of elicited fear and hope will interact with the probabilities of an outcome and influence decision-making. Simply put, affective-laden outcomes are most influential when probabilities move from impossible (i.e., 0% chance of occurrence) to possible (e.g., 5% chance of occurrence), compared to when the same outcome has an intermediate probability (e.g., 50%; Rottenstreich & Hsee, 2001). Thus, in the context of crime, risk, and deterrence, an additional explanation for observing diminishing sensitivity may be found in how such potential negative outcomes make people feel. For example, the simple possibility of getting arrested (i.e., any non-zero probability), incites fear and thus influences decision-making. However, an increase in the probability of arrest does not lead to an increase in fear. Indeed, subjective fear of incarceration does not increase as a function of the amount of time to serve (Study 3 in Pickett, 2018). Thus, in the context of crime, the relationship between costs and deterrence may be dichotomous because any non-zero probability elicits approximately the same amount of fear, and this fear may be driving decision-making and behavior. However, traditional RCT and deterrence perspectives that only model the cognitive portion of human decision-making cannot accommodate such an explanation as they do not model immediate, visceral emotions.

According to the Hot/Cool framework of criminal decision-making (Van Gelder, 2013), visceral and immediate emotions alongside deliberation drives criminal behavior. Important to this theory is the distinction between visceral affective states and future or anticipated feelings. The Hot/Cool framework recognizes that traditional decision-making models of criminal behavior can already accommodate anticipated emotions as an additional cost or benefit (Van Gelder, 2013). For example, the shame or guilt an individual may experience after committing

a crime is an anticipated emotion that is not experienced at the time but modeled as a future cost and may deter criminal behavior (e.g., Braithwaite, 1989; Clarke & Homel, 1997; Svensson et al., 2017b; Tangney et al., 2011; Wikström et al., 2012). Shame and guilt both relate to reoffending (*recidivism*; Hosser et al., 2007) and intentions to offend (Tibbetts, 2013). Moreover, such emotions modeled as a future cost is highlighted by how it is typically assessed with researchers asking questions such as, 'How ashamed *would you feel* if you *had been* caught for…' and 'How guilty *would you feel* if you…' (Svensson et al., 2013). Conversely, "Direct visceral reactions to risk, such as anger, fear and sexual arousal, on the other hand, implicate the hot mode and are difficult, if not impossible, to plausibly model as costs or benefits; they are simply there" (Van Gelder, 2013, p. 753). In other words, state emotions may act as biases or heuristics that influence the decision-making process (e.g., Carmichael & Piquero, 2004; Druckman & McDermott, 2008). Such a proposition directly aligns with a number of psychological theories assessing the relationship between emotion and decision-making (e.g., Clore et al., 2001; Clore & Huntsinger, 2007; Lerner et al., 2015; Loewenstein et al., 2001; Slovic et al., 2004).[8]

In addition to the discussion on diminishing sensitivity and fear above, consider the Somatic Marker Hypothesis which states that through experiences individuals associate alternatives with certain emotions and these emotions give rise to physiological responses that guide decision-making (Damasio et al., 1996). In this framework, individuals avoid a potential negative outcome (e.g., a criminal behavior) because the simple thought of it makes them feel negative emotions such as uneasiness, anxiety, or physiological sickness.

In a similar vein, as suggested by Misattribution Theory, unrelated affective mood states can influence judgment (Messner & Wänke, 2011; Schwarz & Clore, 1983).[9] In other words, Misattribution Theory states that emotions derived from one context can influence our decision-making in another context. For example, when made to experience disgust (e.g., by being in a dirty room) participant make more severe judgments of moral violations. Conversely,

[8]Some psychologists have debated if emotions can occur without a cognitive antecedent (e.g., Lazarus, 1982; Zajonc, 1980); however, such a topic is not the focus of this thesis. It is possible that the spirit underscoring this debate is the fact that emotions have traditionally been viewed as a second-rate function compared to decision-making calculus. Best stated, "Emotions have traditionally been regarded as extras in psychology, not a serious mental functions like perception language, thinking, and learning" (Oatley & Jenkins, 1996, p. 122). Therefore, imposing their importance may have sparked an interdisciplinary debate.

[9]In this context, unrelated describes an affective mood state not catalyzed by the current decision-making process. For example, waking up in a good mood and being more positive or risk-taking throughout the day.

when made to experience a sense of purity, participants make less severe judgments of moral violations (e.g., Schnall, 2017; Schnall, Benton, et al., 2008; Schnall, Haidt, et al., 2008). In this case, feelings unrelated to the decision-making context at hand were observed to directly influence the judgment of a moral violation. Visceral emotions may also indirectly influence decision-making by modifying how information is processed. Generally, being in a positive mood tends to promote auto-pilot, heuristic, and top-down processing while being in a negative mood is more associated with bottom-up processing and calculated attention to details (Gasper & Clore, 2002).

In sum, the psychological literature surrounding emotion supports the proposition that visceral emotions directly influence decision-making by acting as information that indicates how one feels about a situation as well as indirectly by influencing how information is processed (e.g., the perception of risk and benefits of a given situation). Such a proposition cannot be accounted for in a theoretical perspective that only has a single, cognitive, decision-making system. As such, several theorists both within and outside of criminology have expanded the traditional decision-making model to that of a dual-process model (e.g., Gigerenzer & Gaissmaier, 2011; Mamayek et al., 2015; Metcalfe & Mischel, 1999; Paternoster & Pogarsky, 2009; Pickett & Roche, 2016; Sloman, 1996; Strack & Deutsch, 2004; Thomas & Mcgloin, 2013; Van Gelder, 2013).

Much like the early phase editing and evaluation processes presented in the original Prospect Theory (Kahneman & Tversky, 1979), system 1, or the *intuitive system*, is typically considered to be an emotive and fast process unconcerned with probabilities or future outcomes. Conversely, system 2, or the *deliberative system*, aligns with the traditional deterrence framework and is a slow, analytical process that weighs the costs and benefits of each alternative.[10] Decisions and behaviors resulting from the intuitive system are considered heuristics. Such decisions and behaviors account for the majority of human behavior and result in the irrationalities discussed above (e.g., diminishing sensitivity; Kahneman, 2011). While there has been debate regarding which decision-making system one should use or is 'the correct one' (e.g., Gigerenzer, 2008; Kahneman, 2011), what should be emphasized is the considerable consensus on a dual-processes perspective as an accurate model for human decision-making

[10]While certain neurological structures may become associated with various decision-making capabilities, such theorists do not imply physical manifestations of the systems within the brain.

and behavior.[11] Compared to the traditional rational perspective, a theory which takes into account the intuitive system will help advance a more cohesive model that may better describe more parameters of human behavior and decision-making, and as a result increase the pragmatism of any resulting policy.

To summarize, while the traditional RCT perspective has proven to be a useful starting point in criminal decision-making, by only modeling a rational agent which calculates and weighs all available alternatives (albeit imperfectly) and neglecting to consider the influence of immediate, visceral emotions, it has failed to accurately model human decision-making and proven to be less than effective as a framework for a justice system. As such, there is a need for criminal decision-making models to be expanded to reflect dual-process theories by including a second, intuitive decision-making system. Therefore, in this doctoral thesis I advance a model of criminal decision-making that takes into account both deliberate, cognitive, and calculating psychological processes as well as intuitive, heuristic, and affective-laden psychological processes.

While some have argued that humans are more likely to use their intuitive system in any given moment (Gigerenzer & Gaissmaier, 2011; Kahneman, 2011), it is also suggested that reliance on each system varies depending on the situation and individual differences (Hamilton, Shih, & Mohammed, 2016; van Gelder & de Vries, 2014). Such a premise allows for the natural integration of a distal correlate alongside a proximal dual-process theory.

Distal Theories: Self-control

As indicated above, distal theories presume that criminal behavior is the result of stable characteristics (e.g., psychopathy; Cleckley, 1941) that make up individuals' criminal propensities. The higher the propensity, the more likely crime is to occur in any given situation. A number of stable characteristics have been proposed as distal factors of interest in relation to criminal behavior, such as: hereditary and intergenerational crime (Rowe & Farrington, 1997); neuropsychological deficits (Ogilvie et al., 2011); empathy (Jolliffe & Farrington, 2004); and sensation-seeking (White, Labouvie, & Bates, 1985). One of the most researched distal

[11]However, Kruglanksi and Gigerenzer (2011) offer a dissenting view in which both the deliberative and intuitive processes are derived from the same rule-based approach.

correlates of criminal behavior is self-control. Although the exact definition has varied (e.g., Baumeister et al., 2007; Gottfredson & Hirschi, 1990; Maloney et al., 2012; Mamayek et al., 2015; Pratt & Cullen, 2000; Van Gelder & De Vries, 2014), self-control is generally understood to be the ability to override short-term orientated initial responses to a cue or stimulus for the promotion of long-term outcomes. Arguably, the most prominent model of trait self-control in relation to criminal behavior is derived from Gottfredson and Hirschi (1990).

Gottfredson and Hirschi characterized self-control (particularly low self-control) as a stable trait that could be described as hyper-focusing on the present with a tendency to prefer quick gratification and disinterest in long-term outcomes. The low self-control construct consisted of six characteristics: impulsivity, self-centeredness, preference for physical activity, preference for simple tasks, risk-taking, and poor temper (Arneklev et al., 1999). Although self-control is generally thought to be a multi-dimensional construct, the inclusion of factors such as preference for physical activity and simple tasks introduce behavioral markers that create a tautological problem when assessing self-control in relation to antisocial behavior (Malouf et al., 2014). That is, by including explicit behaviors within the definition and resulting measurement (i.e., Grasmick et al., 1993), researchers contaminate their conceptualization of self-control with related, but distinct constructs and/or manifestations of self-control, rather than aspects of it. As such, there has been a considerable amount of interest in defining and measuring self-control in regard to criminal behavior.

Although a number of theories, perspectives, models, and resulting measures differ in terminology and specifics (often driven by contextual differences),[12] psychologists have sought to describe self-control as a function of two similar, yet distinct concepts: impulsivity and restraint (for a summary and comparison see: Carver, 2005). At the basic level, much like the two systems of decision-making, restraint and impulsivity are two distinct yet interrelated processes that work in tandem with one another (Maloney et al., 2012). That is, the process of using self-control includes: 1) a tempting cue or stimulus, 2) an impulsive desire to succumb to the temptation often at the expense of longer-term goals, and 3) the restraint to prevent or override the impulsive desire (Mamayek et al., 2015). It is suggested that individuals will naturally vary as both a trait and state in regard to impulsivity and restraint. If an individual is

[12]As a concept, self-control has suffered from the jingle (self-control is defined differently across domains) and jangle (different terms are used to describe the same phenomenon) empirical problem found within social sciences (Kelly, 1927).

low on the impulsive construct, they do not need to be high on the restraint construct to override their instincts and resist temptation. Conversely, if someone is highly impulsive, they will require a large amount of restraint to override their impulsive urge and not yield to temptation. Thus, regarding the manifestation of a behavior, low self-control is not synonymous with impulsivity, but instead is two interdependent constructs. Failing to model either construct may lead to model misspecification (Maloney et al., 2012; Mamayek et al., 2015). Thus, in this doctoral thesis, rather than using the traditional criminological definition and measurement of self-control, I chose to use the psychological approach by accounting for both impulsivity and restraint.

Assessment of Criminal Decision-making

The study of criminal behavior and decision-making has always been met with methodological and ethical limitations. Retrograde interviews potentially bias participants and are pragmatically limiting (Schlosser, 2008), official crime statistics are flawed in numerous ways and lack psycho-social data (Walsh, 2011), and self-report measures succumb to a social desirability bias (Krumpal, 2013). Traditionally, researchers have sought to circumnavigate such issues by using a vignette design.

In a vignette design, participants are given a scenario to read and imagine, followed by responding with how they may behave in that situation. Such a paradigm allows researchers to gather large amounts of data that includes individual differences (e.g., trait self-control) and social aspects (e.g., family or educational background). Moreover, researchers may also experimentally manipulate certain parameters of the scenario to see how they influence criminal decision-making (e.g., including the presence or absence of a police officer or informal enforcer; Cohen & Felson, 1979). While the written vignette design has improved our understanding of criminal behavior and decision-making, it is not without its flaws, particularly regarding how "real" the scenario seems and how present a participant feels in the moment when imagining that scenario. As such, in the second half of this doctoral thesis I examined the differences in presenting a hypothetical scenario as written text to novel methodology such as Virtual Reality (VR) and videos. In doing so, I evaluated if such approaches lead to differences in criminal intention, higher presence, higher subjective realism, and overall better ecological validity.

Additionally, vignettes are often assessed alongside factors that researchers deem important using a close-ended format. While always driven by theory (e.g., the likelihood of getting arrested; Cornish & Clarke, 1986), it is possible that participants *naturally* consider and are driven by a different set of parameters entirely (Exum & Bouffard, 2010; Schwarz & Hippler, 1990; Schwarz & Oyserman, 2001). Moreover, these factors may also differ depending on if the hypothetical scenario is presented using a traditional written approach or more novel approaches such as VR and videos. Therefore, in the second half of this thesis I also used open-ended questions to assess what factors people naturally consider when making their decisions and if such factors differ in regard to how the hypothetical scenario is presented.

Contributions of this Thesis

Over four empirical chapters alongside a general introduction and discussion, this thesis offers major advancements to the criminal decision-making literature, both theoretical and methodological. This was accomplished by taking a mixed-methods approach using a wide range of experimental and non-experimental methodologies, as well as quantitative and qualitative data.

Firstly, inspired by the Hot/Cool framework of criminal decision-making (Van Gelder, 2013) throughout this doctoral thesis I examine and demonstrate that factors related to intuitive decision-making such as emotions, heuristics, and norms associate with criminal decision-making. Moreover, this relationship maintains when controlling for factors indicative of the traditional proximal perspective (e.g. risk of arrest) and distal individual differences (e.g. trait self-control). In Chapter Two, using a large scale survey I first established a relationship between trait self-control, a dual-process model of decision-making, and Self-reported Criminal Behavior (SRCB; McClanahan et al., 2019). Most notably, an intuitive decision-making style was significantly positively related to self-reported criminal behavior (McClanahan et al., 2019). Using a traditional vignette design and Structural Equation Modeling (SEM), in Chapter Three both positive and negative state affect were significantly associated with criminal choice (McClanahan & van der Linden, 2020). Specifically, state negative affect was negatively related to criminal choice while state positive affect was positively related to criminal choice. Exploratory analyses yields initial support for positive state affect being the strongest predictor of criminal choice. The same relationship was also observed in Chapter Four when using novel virtual reality methodology. Moreover, in Chapter

Five when asked open-ended questions participants naturally indicated affective components drove their decision-making and behavior in relation to aggression, most notably state anger. Finally, there was initial evidence in Chapters Four and Five, that the above predictors of criminal behavior also predict law-abiding behavior to a similar degree, albeit in the opposite direction. In sum, this thesis provides critical contributions to the criminal decision-making literature by illustrating the robust relationship between state affective components and criminal decision-making using a variety of methodologies and analyses. However, and very importantly, in all cases, the most predictive model was a model that combined individual differences, intuitive decision-making, and cognitive decision-making elements. Thus, the results of this thesis should not be taken to as reason to omit rational decision-making components from future works, but instead highlights their importance relative to individual differences and intuitive factors such as state emotions.

Secondly, rather than examining self-control through the lens of criminology, the psychological perspective was taken. Taking such a perspective allowed me to test the robustness of traditionally observed relationships when using new measures. In Chapter Two, although trait self-control held the traditionally observed negative relationship with self-reported criminal behavior, the majority of the influence was mediated by intuitive decision-making (McClanahan et al., 2019). That is, trait self-control was negatively associated with intuitive decision-making which in turn was positively associated with self-reported criminal behavior. Additionally, by taking the psychological perspective on trait self-control I was able to examine how fluctuations in state self-control influences criminal decision-making. In Chapter Three, using a standard ego-depletion task I sought to examine how fluctuations in state self-control (i.e., low state self-control) directly influenced criminal decision-making as well as indirectly by modifying how risk, state affect, and perceived social consensus predicted criminal decision-making. While participants were successfully depleted, there was no main effect of ego-depletion on criminal behavior. However, although perceived risk, a central tenant of RCT, predicted criminal decision-making for non-depleted participants, it did not predict criminal decision-making for depleted participants (McClanahan & van der Linden, 2020). In Chapter Four, I sought to expand on the null results of ego-depletion on criminal decision-making by using novel virtual reality methodology. Returning similar results, participants were no more likely to offend when depleted and experiencing a scenario in virtual reality. I situate the findings from these two chapters within the criminology and heavily debated ego-depletion literature (e.g., Dang, 2018a; Dang et al., 2020; Hagger et al., 2010, 2016) in Chapter Six of

this thesis. In the context of criminology, I highlight that although state self-control may influence the factors that drive our decision-making in the moment, the direct relationship may be moderated by morality. More generally, I provide several critical considerations for the greater ego-depletion literature in relation to task design and ecological validity.

Thirdly, in addition to theoretical advancements, in this thesis I provide methodological advancements by assessing the integrated, dual-process decision-making model using novel VR, video, and open-ended question methodologies. In Chapter Four I assessed how immersion, rather than imagination, influenced criminal behavior. Although participants that experienced the vignette in VR were no more likely to choose a criminal behavior, participants in the VR condition did indicate a significantly greater subjective presence than participants that read the same vignette. Expanding on the findings of Chapter Four, in Chapter Five, I used a video to display the same hypothetical scenario as in Chapter Four. Participants in the video condition indicated a greater subjective presence than participants that read the same vignette. Replicating the findings of Chapter Four, there was no difference in criminal behavior based on how the vignette was presented (i.e., video or written text). Although producing similar results, it does appear that presenting a vignette using virtual reality has different underlying causal effects than using a video or the traditional written method. Specifically, Chapters Four and Five provide initial evidence that participants that experience the vignette in virtual reality indicate more presence, which in turn leads to more state affect (in this case anger), which then positively influences aggression. The same relationship was not observed for participants in the written condition nor the video condition. However, and as discussed more generally throughout the two chapters and general discussion (Chapter Six) future researchers need to establish which methodology (Virtual reality, Video, or written) has the greatest ecological validity.

Finally, by using open-ended questions to assess what factors individuals naturally consider when making decisions, I was able to examine the boundary conditions of how researchers typically assess criminal decision-making. While some factors align with existing distal theories (e.g., trait self-control and aggressiveness) and the overall RCT framework (e.g., likelihood of getting arrested) several factors do not such as, emotions, heuristics, and norms (Chapter Five). Importantly, the number and types of predictors provided did not differ based on how the vignette was presented. Thus, regardless of methodologies, Chapter Five indicates that people often consider factors that are not traditionally examined by researchers.

In sum, by using both criminological and psychological theories I have provided theoretical advancements that highlight the deficits of only examining individual differences *or* decision-making, as well as the limitations of only modeling a rational decision-making system. Specifically, I advanced the importance of using a dual-process system alongside individual differences to accurately model criminal decision-making. Additionally, comparing a variety of novel and traditional methodologies, I offer practical insights regarding how using different methods may directly and indirectly influence theories surrounding criminal decision-making. The results and implications of this thesis are discussed concurrently in relation to the greater literature in a general discussion (Chapter Six).

Chapter Two: Decision-making Styles Mediate the Relationship Between Trait Self-control and Self-reported Criminal Behavior[13]

The purpose of this chapter was to establish a relationship between the variables of interest as defined here that either differ from previous definitions (i.e., self-control) or modify previous constructs by expanding them (i.e., moving from a single- to dual-process model). In this chapter, I examined decision-making in relation to trait-level differences and criminal behavior. Using a relatively novel measure of decision-making styles (Hamilton et al., 2016), I examined if a dual-process decision-making model mediates the relationship between trait self-control and self-reported criminal behavior.

Dual-process Decision-making and Criminal Behavior

The relationship between decision-making processes and criminal behavior is complex and may be situational or crime specific. For example, White Collar Crime is considered to require greater amounts of deliberative decision-making (Huisman, 2017), while emotions, an aspect of intuitive decision-making, are considered primary drivers of violent crime (e.g., Athens, 2005). Furthermore, carjacking is suggested to require both immediate visceral reactions (e.g., intuitive decision-making) and rational or planned steps (e.g., deliberative decision-making; Cesar & Decker, 2017). However, more generally crime may be the result of reduced executive functioning or reliance on intuitive or unsystematic thinking (Foroozandeh, 2017), whereas more deliberative decision-making is negatively associated with criminal behavior (e.g., Thoughtful Reflective Decision Making; Heller et al., 2016; Ray Paternoster & Pogarsky, 2009).

Self-control and Criminal Behavior

Regardless of which explicit definition or measurement has been used, self-control has consistently been observed to be negatively related to criminal behavior (de Ridder et al., 2012; Pratt & Cullen, 2000). In an ecologically valid sample of known offenders that were soon to be released from jail, trait self-control negatively related to substance abuse and criminal

[13]Although slight modifications have been made to promote a cohesive thesis, this chapter and resulting findings have been published (McClanahan et al., 2019).

history before incarceration, and also was negatively related to recidivism after release (Malouf et al., 2014). Additionally, positive changes in self-control through a form of rehabilitation or treatment relate to reduce rates of recidivism (Piquero et al., 2010; Serin et al., 2013). That is, treatment increased self-control which in turn decreased the likelihood of recidivating. In sum, self-control is generally negatively associated with criminal behavior.

Self-control and Decision-making Styles

Self-control is suggested to be a distinguishing factor regarding decision-making styles (e.g., Kahneman, 2011) and a driving factor of deliberative decision-making (Mamayek et al., 2015). Higher-order forms of thought (e.g., estimating unknowns) are suggested to require executive functioning and self-control, while more simple and intuitive decisions do not (e.g., Pocheptsova, Amir, Dhar, & Baumeister, 2009). Moreover, key indicators of intuitive decision-making (e.g., discounting delayed rewards) are suggested to negatively relate to self-control but positively relate to impulsiveness (Wittmann & Paulus, 2008).[14]

Considering the above literature, it was hypothesized that:

> **H1** – Deliberative decision-making would have a direct negative association with self-reported criminal behavior
>
> **H2** – Intuitive decision-making would have a direct positive association with self-reported criminal behavior
>
> **H3** – Trait self-control would negatively associate with self-reported criminal behavior

As general trait-levels of decision-making styles were assessed, it was hypothesized that:

> **H4** – Trait self-control would have a direct positive association with deliberative decision-making
>
> **H5** – Trait self-control would have a direct negative association with intuitive decision-making

[14]Trait self-control has also been observed to positively relate to automatic behavior which some have taken to suggest a positive relationship with intuitive decision-making (de Ridder et al., 2012). However, this relationship may be the result of habitual formation (Gillebaart & de Ridder, 2015). That is, the positive relationship between trait self-control and automatic processing (e.g., the intuitive system) may be the result of repeated effortful processing (e.g., the deliberative system) allowing for habitual formation and decisions to be made quicker in specific contexts (e.g., Expert intuition; Salas et al., 2010). This suggests that relationships between self-control and automatic behaviors may be context specific (e.g., dieting).

H6 – Intuitive and deliberative decision-making styles would be negatively correlated[15]

Method

Participants

Participants were recruited through the online labor crowdsourcing platform, Prolific Academic (Peer et al., 2017). Meta-analyses have shown that trait self-control has an average effect size of $d = 0.20$ in relation to criminal behavior (Pratt & Cullen, 2000). A conservative effect size of 0.15 was used for an *a priori* power analysis. Utilizing G*Power (Faul et al., 2007), the power analysis revealed that with an alpha of 0.05 and power of 0.90, at least 374 participants were needed to observe minimum correlations of 0.15. To ensure sufficient power, in total, 476 participants completed the survey, 57% were male and 43% were female (1 participant indicated other). As indicated in Table 1, the average age of the participants in years was 33 ($SD = 11$). Lastly, in terms of ethnicity, 86% were White, 6% were Asian, 3% were Multi-racial, 3% were Black, African, or Caribbean, and 2% indicated other or preferred not to answer.

Table 1

*Sample Characteristics (*N *= 476)*

Characteristic	Mean or Modal Response
N	476
Sex	57% Male
Age	$M = 33$ ($SD = 11$)
Ethnicity	Modal Response (86%) - White
Employment Status	Model Response (40%) – Full time employment
Education	Modal Response (67%) – Undergraduate or Higher
Marriage Status	Modal Response (50%) - Single

Procedure

Through an advertisement on Prolific (Appendix A; Advertisement 1) participants were invited to complete a study on how attitudes and beliefs influence decision-making and

[15]In the original development of the decision styles scale used within this study, the intuitive and deliberative styles negatively correlated with one another (Hamilton et al., 2016).

behavior. Consenting participants (Appendix B; Consent Form 1) followed the link provided by Prolific and answered all questions via the Qualtrics survey platform (Qualtrics, 2019). All items were presented in random blocks of approximately five questions per block. Upon completing the survey, participants were debriefed and paid £1.10 in compensation (Appendix B; Debrief 1).[16]

Measures

Trait Self-control

The eight-item version of the Brief Self-control Scale ($\alpha = 0.82$, $M = 23.46$, $SD = 6.23$) was used to measure trait self-control (Maloney et al., 2012; Appendix C, Set 1). In this scale, self-control is determined by two dimensions, impulsivity and restraint. All items were scored on a 1 (Not at all like me) to 5 (Very much like me) scale. For analysis, impulsivity items were reverse coded and summed with restraint items to create a single index with higher scores indicating greater levels of trait self-control. Example items include, "I am good at resisting temptation" and "Pleasure and fun sometimes keep me from getting work done".

While the dimensionality of this measure is debated (and the theory of self-control more generally as indicated in Chapter One of this thesis, also see: Lindner et al., 2015), compared to a unidimensional model, a two-dimensional model is suggested to better fit the data, align with previous theories of trait self-control (Hagger et al., 2018), and predict behavioral outcomes (Maloney et al., 2012). Compared to the original scale, the brief version has a correlation of approximately 0.90 and a three-week retest reliability of 0.87 (Morean et al., 2014; Tangney et al., 2004).

Deliberative and Intuitive Decision-making

Considering the limitations of methodologies such as interviews (e.g., Exum & Bouffard, 2010; Raymond Paternoster, 1987), as well as the time constraints and general purpose of this first study, decision-making was assessed as a trait-level variable. The 10-item,

[16]To ensure clear wording and correct survey flow, before the study was launched a pilot-test with a rolling convenience sample was conducted. Data from the pilot-test was not included in the main analysis presented here.

two-dimension, Decision Styles Scale was used to measure the Deliberative (α = 0.89, *M* = 20.51, *SD* = 3.57) and Intuitive (α = 0.88, *M* = 14.63, *SD* = 4.37) decision-making styles (Hamilton et al., 2016; Appendix C, Set 2). The two dimensions of the scale hold high test-retest reliability (0.79, $p < 0.001$, both, respectively) internal consistency, and internal as well as discriminant validity (Hamilton et al., 2016).

All items were on a 1 (Not at all like me) to 5 (Very much like me) scale with higher scores indicating a greater amount of the respective decision-making style. Example items include, "I weigh a number of different factors when making decisions" and "When making decisions, I rely mainly on my gut feelings". Although novel, studies have been able to successfully validate the measure (e.g., concurrent and discriminant validity between participants) in a variety of contexts (Hamilton et al., 2016; Hamilton et al., 2017; Tzini & Jain, 2018).

Self-reported Criminal Behavior

Eight items measuring Self-Reported Criminal Behavior (SRCB) were derived and adapted from the regularly cited National Youth Survey (α = 0.74, *M* = 1.80, *SD* = 4.08; Elliot et al., 1985; Appendix C, Set 3). To reduce social desirability bias, all items are primed with the positively loaded phrase, "In the past 12 months, how many times have you…", participants then indicate the frequency ranging from none (0) to five or more times (5; McNeely, 2012).

The National Youth Survey pool consisted of 45 items regarding criminal and antisocial behavior. By eliminating status offenses only applicable to minors, as well as items that could be considered antisocial but not punishable by law, the pool was reduced to 20 items. Combining repeated questions (e.g., seven distinct questions measuring the use of seven different drugs) into one item (e.g., have you ever used any illegal substance) reduced the pool to eight items. Example items include, "Sold an illegal substance such as, but not limited to, marijuana, heroin, cocaine, LSD?" and "Purposely damaged or destroyed property that did not belong to you?".

Social Desirability Bias

Due to the sensitive nature of some items, there is potential to observe underreporting or a Social Desirability Bias (SDB; Malouf et al., 2014; McNeely, 2012). To control for this, the 13-item, Marlowe-Crowne Social Desirability Scale was used to control for SDB ($\alpha = 0.69$; $M = 5.86$, $SD = 2.81$; Reynolds, 1982; Appendix C, Set 4). All items are in True/False format and scores may range from 0 (low SDB) to 13 (high SDB). Example items include, "I'm always willing to admit when I make a mistake".

This short form is positively correlated ($r = 0.93$) with the full version and has a six-week retest reliability of 0.74 (Zook & Sipps, 1985). The scale has previously been used in studies regarding criminal behavior (Saleem et al., 2016; Straus, 2004). While the scale has been criticized for its age and unidimensional, rather than bi-dimensional nature (Ballard, 1992), other social desirability measures such as The Balanced Inventory of Desirable Responding (Paulhus, 1991) often use criminal or antisocial acts as items in the assessment, thus contaminating the outcome variables of interest (Malouf et al., 2014).

Results

All analyses were conducted in Stata 15 (StataCorp, 2017). Descriptive statistics for each construct and reliabilities are provided in Table 2. Trait self-control exhibited small to moderate but significant correlations with both decision-making styles, while only intuitive decision-making held a significant relationship with SRCB ($r = 0.13$, $p = 0.004$, Table 2). Furthermore, as observed in the original creation of the decision-making scales (Hamilton et al., 2016), deliberative and intuitive decision-making were significantly negatively correlated ($r = -0.35$, $p < 0.001$). Finally, as SDB held significant correlations with both trait self-control and self-reported criminal behavior, it was controlled for in the model.

Table 2

Correlation Matrix and Sample Descriptives

	Deliberative Decision-Making	Intuitive Decision-Making	Trait Self-control	SDB	SRCB
Deliberative Decision-Making					
Intuitive Decision-Making	-0.35***				
Trait Self-control	0.25***	-0.26*			
SDB	0.04	0.00	0.38***		
SRCB	-0.06	0.13**	-0.20***	-0.09*	
Mean (SD)	20.51 (3.57)	14.63 (4.37)	23.46 (6.23)	5.86 (2.81)	1.80 (4.08) [a]
Observed Range	5 – 25	5 – 25	8 – 40	0 – 13	0 – 39
α	0.89	0.88	0.82	0.69	0.74

Notes: SDB: Social Desirability Scale. SRCB: Self-reported Criminal Behavior.

[a] As SRCB is positively skewed towards zero (mean), the median (1.8) and mode (0) are also presented.

* $p < .05$; ** $p < .01$; *** $p < .001$

As Structural Equation Modeling (SEM) allows for the simultaneous estimation of multiple mediators and is a superior technique compared to traditional mediation analysis, SEM and Confirmatory Factor Analysis (CFA) were used to test the hypotheses (Hayes, 2009; Preacher & Hayes, 2008). To reduce unique variance and to manage model complexity, items were parceled before estimation. As the model contains constructs that are both uni- and multi-dimensional, appropriate parceling techniques based on dimensionality were employed for each construct. Where possible, three observed variables were used to create a just-identified construct (Little et al., 2002).

While parceling is continually debated, its use reduces unique variance and increases normality between individual items of the same construct. This in turn reduces the number of parameters to be estimated, model complexity, and increases overall model fit. More specific to this chapter, appropriate parceling may be beneficial when researchers are concerned with the general latent variable (rather than the unique contributions that each dimension of a construct may make up), are transparent about their parceling techniques, and justify them where appropriate (Coffman & MacCallum, 2005; Little et al., 2002, 2013).

The domain representative technique (Kishton & Widaman, 1994) was used to parcel self-control and SRCB. In this technique, items from each dimension are combined into the number of desired parcels (in this case three) until no items remain. For self-control, two three-item and one two-item aggregate score parcels were created by matching restraint items with reverse coded impulsivity items (Appendix D, Supplementary Table S1).[17] For SRCB, two three-item and one two-item aggregate score parcels were created by matching items from the Property, Drug, and Violent crime types (Appendix D, Supplementary Table S1).

The item-to-construct technique was used to parcel decision-making styles and SDB. Items with the highest factor loadings are used as anchors for each parcel and matched to items with the lowest factor loadings. All items are distributed to each parcel in ascending order of factor loading until no items remain (Little et al., 2002). For each decision-making style, two two-item aggregate score parcels and one single item were used (Appendix D, Supplementary Table S1). For SDB two four-item aggregate and one five-item aggregate score parcel were created (Appendix D, Supplementary Table S1).[18]

All models were estimated with maximum likelihood with no missing data and model fit was assessed using a common threshold of 0.08 for Root Mean Square Error of Approximation (RMSEA), 0.08 for Standardized Root Mean Squared Residual (SRMR), and 0.95 for the Comparative Fit Index (CFI) as well as the Tucker-Lewis Index (TLI; Kline, 2005). Following general procedure (e.g., Acock, 2013) a CFA was first conducted in which all variables of interest were allowed to freely correlate with one another. The CFA model demonstrated a good fit to the data ($\chi^2(80) = 135.62$, $p < 0.001$; RMSEA = 0.04, 90% CI [0.03, 0.05]; CFI = 0.98; TLI = 0.98; SRMR = 0.04; Appendix E, Supplementary Figure S2) with all factor loadings significant ($p < 0.001$) ranging from .49 to .89 (Appendix D, Supplementary Table S1). As anticipated, the correlation between latent factors returned similar estimates as the correlation matrix. As such, I moved forward with the structural model.

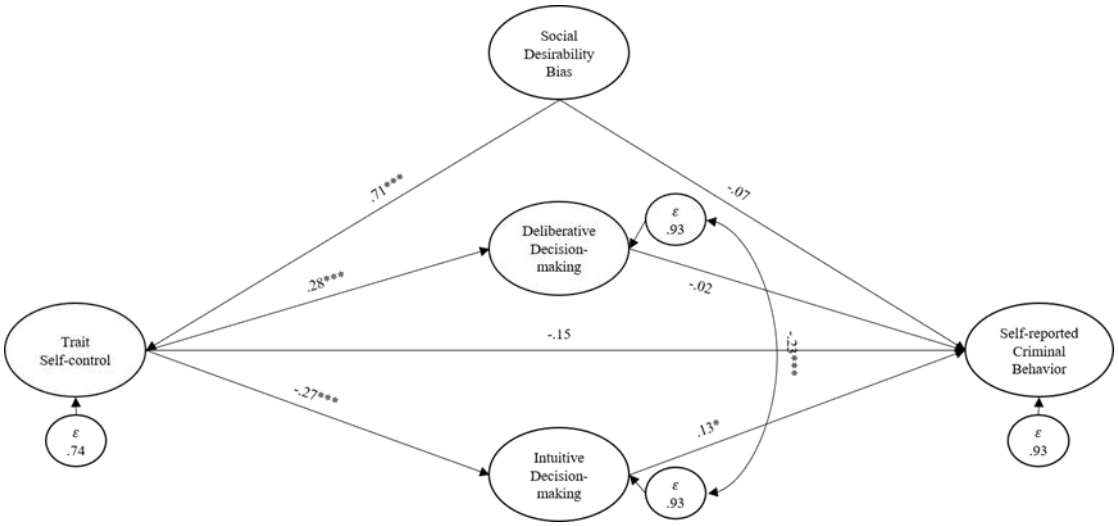
[17]Parcels do not need to consist of the same number of individual items in ordered to be considered balanced (Little et al., 2002).

[18]Factor loadings for parceling were derived from a full model CFA (i.e., all observed indicators loaded onto their respective latent factor) in which all latent variables were allowed to freely correlate with one another. Model fit: ($\chi^2(692) = 1523.759$, $p < 0.001$; RMSEA = 0.05, 90% CI [0.05, 0.05]; CFI = 0.86; TLI = 0.85; SRMR = 0.07; Appendix E, Supplementary Figure S1).

The structural model (Figure 1) demonstrated a good fit to the data ($\chi^2(82) = 146.03$, $p < 0.001$; RMSEA = 0.04, 90% CI [0.03, 0.05]; CFI = 0.98; TLI = 0.97; SRMR = 0.05) with factor loadings ranging from .49 to .89 ($p < 0.001$) and explaining 6.55% of the variance in SRCB. As the decision-making measure assesses two interrelated, but distinct types of decision-making (intuitive and deliberative) that were found to negatively correlate with one another (Hamilton et al., 2016), I allowed the constructs to remain independent of one another with their error terms correlated. As hypothesized, the two decision-making styles negatively correlated (r = -0.23, 95% CI [-0.31, -0.15], $p < 0.001$).

Figure 1

*Mediation Model of Decision-making Styles and Trait Self-Control on SRCB (*N = *476)*



Notes. Coefficients are standardized. Parcels and respective factor loadings can be found in Appendix D and E, Table S1 and Figure S3. * $p < .05$; ** $p < .01$; *** $p < .001$

As hypothesized, trait self-control positively (β = 0.28, 95% CI [0.18, 0.39]) and negatively (β = -0.27, 95% CI [-0.37, -0.16]) associated with deliberative and intuitive decision-making, respectively ($p < 0.001$). Intuitive decision-making held a significant positive association with self-reported criminal behavior (β = 0.13, 95% CI [0.01, 0.26], p = 0.035), while deliberative decision-making did not (β = -0.02, 95% CI [-0.13, 0.09], p = 0.712). Indicating mediation, trait self-control had a marginally significant direct effect (β = -0.15, 95% CI [-0.29, 0.00], p = 0.052), but had a significant indirect effect (β = -0.04, 95% CI [-0.08, -0.00], p = 0.041). Using the *medsem* package in Stata (Mehmetoglu, 2018), 14% of the indirect effect was observed through deliberative decision-making (β = -0.01, 95% CI [-0.04, .03], p =

0.712), and 86% was observed through intuitive decision-making (β = -0.04, 95% CI [-0.07, -.000], p = 0.049).[19]

Thus, there is significant mediation through intuitive, but not deliberative decision-making. The total significant negative effect of trait self-control on self-reported criminal behavior was -0.19 (95% CI [-0.32, -0.05], p = 0.008). Lastly, several robustness checks illustrate the consistency of the current model.[20] Additional models controlling for gender, without parcels, a two-factor self-control latent variable, and using a variety instead of frequency self-reported criminal behavior scale (i.e., Sweeten, 2012), all returned very similar model fit and parameter estimates (Appendix E, Supplementary Figures S4 – S7).

Discussion

In this chapter, a recently developed, trait-level measure of decision-making styles was used to explore the relationship between trait self-control, decision-making styles, and SRCB. In congruence with the hypotheses and literature (Pocheptsova et al., 2009), self-control was positively and negatively associated with deliberative and intuitive decision-making, respectively. As such, null Hypotheses 4 and 5 can be rejected. Moreover, in agreement with the literature (e.g., Pratt & Cullen, 2000) trait self-control was negatively associated with SRCB, thus null Hypothesis 3 may also be rejected. Finally, allowing for the rejection of null Hypothesis 6, as with the original creation of the scale (Hamilton et al., 2016) the two decision-making processes were negatively correlated. In partial alignment with prior research (Paternoster & Pogarsky, 2009; van Gelder & de Vries, 2014), although intuitive decision-making was significantly associated with self-reported criminal behavior, deliberative decision-making was not. Therefore, null Hypotheses 2 and 1 are rejected and retained, respectively.

Overall, these findings suggest that increased trait self-control is associated with less SRCB, but this relationship was mediated by decision-making styles. Particularly, as most of the indirect effect of self-control was observed through intuitive decision-making, lower levels of self-control are associated with intuitive decision-making, which in turn is associated with

[19]Given the non-significant beta coefficient between deliberative decision-making and SRCB, other unmeasured variables could influence this observed relationship.
[20]These additional model specifications were raised by reviewers during the publication process.

more criminal behavior. This suggests that the contribution of self-control to criminal behavior may be the result of an indirect relationship via decision-making styles and warrants future work that specifically examines which style promotes or deters criminal behavior under specific conditions.

For example, affect and immediate emotions are considered to be processed through the intuitive system (Van Gelder, 2013). Positive affect can promote risky decision-making (Johnson & Tversky, 1983) and thus may increase criminal behavior. Conversely, negative state affect has been observed to negatively associate with criminal behavior (Van Gelder & De Vries, 2014). Although lower levels of self-control may promote intuitive decision-making, positive or negative state emotions may moderate the influence that intuitive decision-making has on criminal behavior.

Finally, although not a hypothesized relationship, it should be noted that the strongest relationship observed was between trait self-control and SDB. This is not a unique finding when using the measures used within this study. Specifically, when creating the original version of the trait self-control scale used here, both the short and long form held strong correlations with the Marlowe-Crowne SDB scale (r = 0.56 - 0.60; Tangney et al., 2004). There are two ways to interpret this correlation. First participants may respond to trait self-control scales in a socially desirable manner, representing a true bias (e.g., Stavrova & Kokkoris, 2017). Secondly, it has been suggested that people with high self-control truly display more socially desirable behavior simply because they have the capacity to do so (Uziel, 2010). That is, since socially desirable behavior usually comes at the immediate cost of hedonistic or self-serving pleasure for the potential of longer term goals, self-control would be required to exhibit it. While determining the true relationship may be problematic, by at minimally controlling for SDB in analyses, researchers may have more confidence in their findings. That is, by controlling for SDB in analyses, researchers may be able to comment on the relationship between self-control and an outcome variable while accounting for the influences of SDB.

Limitations

When interpreting these results several limitations must be kept in mind. First, the study assessed associations between variables that were not experimentally manipulated, and while statistical mediation is present and model fit was good, other models may be possible and

causality should not be assumed. This is perhaps most notable between decision-making styles and trait self-control. Specifically, as both factors are measured at the trait level, the temporality could be debated. That is, although I have theorized decision-making styles mediate the relationship between trait self-control and SRCB, with the current non-experimental study design I cannot exclude the possibility that the mediation occurs the other way. Thus, it is possible trait self-control mediates the relationship between decision-making styles and SRCB.

However, when running an additional SEM in which the trait self-control mediates decision-making styles and SRCB, although the model fit is good and returns similar estimates, there is no statistical mediation between decision-making styles and SRCB. Specifically, although deliberative decision-making positively associates with trait self-control ($\beta = 0.17$, 95% CI [0.07, 0.26], $p = 0.001$) and intuitive decision-making negatively associates with trait self-control ($\beta = -0.22$, 95% CI [-0.32, -0.12], $p < 0.001$), neither have an indirect negative effect on SRCB ($\beta_{deliberative} = -0.02$, 95% CI [-0.05, 0.01], $p = 0.110$; $\beta_{intuitive} = 0.03$, 95% CI [-0.01, 0.07], $p = 0.09$). Importantly, the direct effect of intuitive decision-making on SRCB remains ($\beta = 0.13$, 95% CI [0.01, 0.26], $p = 0.035$). However, moving from the main model with multiple mediators to a model with a single mediator, may have influenced this relationship. Additionally, and perhaps more importantly, when examining the greater literature, prenatal antecedents and normative brain development are regularly highlighted as important predictors of self-control before decision-making styles and criminal behavior (Altikriti, 2020; Moffitt, 1993; Moffitt et al., 2002; Moffitt et al., 2011). These factors support the temporal relationship as designed within this study, nonetheless, future researchers may wish to consider experimental manipulation in relation to decision-making styles and self-control in order to establish a more compelling argument for mediation.

Second, as many variables were Likert-style and thus categorical in nature, the multivariate normality assumption was violated. However, maximum likelihood parameter estimates are relatively robust to reasonable violations of normality,[21] especially when there is no missing data, as is the case here (McDonald & Ho, 2002; Savalei, 2008). Third, although parceling is debated, because general latent variables were examined rather than the unique

[21]Excluding self-reported criminal behavior which was skewed towards zero, all univariate skewness (0.06-0.16) and kurtosis (2.4-4.19) statistics were well-below the recommended cut-offs of 2 and 7, respectively (Hancock & Mueller, 2006; Appendix D, Supplementary Table S2).

contributions of their respective dimensions, parceling was warranted (Little et al., 2002). This limitation is most pronounced in the measure of trait self-control.

As indicated in the literature describing the measure of trait self-control, while the dimensionality of self-control is debated, I selected a measure that aligns with the definitions used within psychology (e.g., Carver, 2005) and is best empirically supported (e.g., Hagger et al., 2018; Maloney et al., 2012; Malouf et al., 2014; Morean et al., 2014). Nonetheless, it has been suggested that the chosen measure is observed to mainly assess Conscientiousness while other measures (e.g., Grasmick et al., 1993) tap into other personality facets (De Vries & Van Gelder, 2013). Therefore, although the results of the model are in line with the general linear patterns observed in the correlation matrix and more broadly with the conceptualization of self-control, future researchers should replicate this model using different measures of self-control, as well as with and without parceling where possible.

Some may suggest that there is conceptual overlap between self-control and a dual-process theory of decision-making (e.g., Metcalfe & Mischel, 1999). That is, intuitive decision-making may be argued to be the same as a lack of restraint or the presence of impulsivity. However, as indicated in the literature review, high levels of self-control are observed to be positively related to intuitive decision-making in specific circumstances. Particularly, people may develop habits through repeated deliberative decision-making and effortful processing (de Ridder et al., 2012; Gillebaart & de Ridder, 2015). Furthermore, within this study, self-control items are in a more general context while the decision-making style items are set in a specific context of making a decision and only small correlations were observed in the anticipated direction (r = -0.26, $p < 0.001$; Hamilton et al., 2016). This supports the notion that while the underlying constructs of self-control and the decision-making scales may be similar, they are nonredundant and hold discriminant as well as concurrent validity.

By utilizing a more explicit measure of decision-making styles, I sought to reduce potential biases that occur from retrograde interviews. Having said this, the measure still requires participants to reflect on how they make decisions (i.e., meta-cognitive processes) that may lead individuals to indicate they do or do not make decisions in a particular manner. Although some may therefore criticize the use of a relatively novel measure of decision-making styles, the results replicated the overall model fit, factor loadings, and negative correlation of the two decision-making styles as reported in the measurement's original development

(Hamilton et al., 2016). As such, this study provides further credence to the validity and utility of this measure in different behavioral domains.

Lastly, self-report surveys may be criticized as unable to predict future criminal behavior and are arguably influenced by SDB which may result in the underreporting of criminal behavior. That is, while previous criminal behavior is generally suggested to be an important predictor of future criminal behavior (e.g., Bonta & Andrews, 2017), it is not a perfect predictor. Additionally, since self-report measures are limited in both timeframe (i.e., within the past 12 months) and in participants' ability to recall such information, the level of imperfection is compounded. This level of imperfection in the outcome variable may have influenced the observed relationships within this chapter. For example, although there was no significant relationship between deliberative decision-making and SRCB reported here, had a more accurate measure of criminal behavior been used (e.g., official arrest records), a negative relationship may have been observed.

Nonetheless, provided that self-report measures are designed appropriately, such as assessing a range of criminal behavior (e.g., common infractions as well as more serious crimes), self-report measures are no less, if not more accurate, than indexed crime reports (Huizinga & Elliott, 1986; Thornberry & Krohn, 2000). In this chapter I used one of the more prominent self-report scales of criminal behavior (e.g., Elliot et al., 1985). Moreover, I measured and attempted to control for SDB in the model. Furthermore, when the frequency measure was transformed into a variety scale, which is sometimes preferable (Sweeten, 2012), model results remained robust and consistent (Appendix E, Supplementary Figure S7). Recognizing these limitations, I encourage future research to test the generalizability and robustness of the models in more ecologically appropriate criminal populations.

Conclusion

Although results failed to support the full model, mediation effects through decision-making styles were observed with nearly all indirect effects occurring through intuitive decision-making. In other words, whereas the traditional RCT perspective assumes decision-making, and thus crime to be the result of cognitive appraisal, the results suggest that crime may also be the result of a more automatic decision-making style. The observed nonsignificant relationship between the deliberative style and self-reported criminal behavior may be due to

the general nature of both variables. Proponents of the classical model of decision-making (e.g., RCT) emphasize that whether the deliberative style promotes or deters criminal behavior depends on situational frames (i.e., perceived cost and benefits). Had I manipulated or examined specific situations, a direct relationship between the deliberative style and criminal behavior as a function of situational characteristics may have been observed. In a similar vein, while in this study a measure that examines two distinct but interrelated decision-making styles was used, at a more general level both decision-making systems may not act in opposition but drive one another (e.g., Strack & Deutsch, 2004), and situational characteristics may affect the degree of influence each system (e.g., Hofmann, Friese, & Strack, 2009).

In sum, the results partially support the utility of a dual-process framework to integrate the distal and proximal perspectives, particularly with the inclusion of intuitive decision-making system mediating the relationship between trait self-control and SRCB. However, interpreting the results as reason to omit examining the deliberative style and factors suggested to be considered by it in future works would be an error. That is, it must be emphasized that the dual-process framework extends, rather than replaces, the traditional RCT perspective (e.g., van Gelder, 2013). In the following chapters I sought to expand on the finding that intuitive decision-making is related to criminal behavior by examining more explicit, rather than general, markers of different decision-making processes. Additionally, rather than examining self-control as a trait variable, I sought to examine how state self-control influences criminal decision-making.

Chapter 3: An Uncalculated Risk: Ego-depletion Reduces the Influence of Perceived Risk but not State Affect on Criminal Choice[22]

Historically, self-control in relation to criminal behavior has primarily been examined as a consistent trait across a variety of domains and time. However, by taking only a trait-based perspective we limit our ability as researchers to develop a cohesive understanding of criminal behavior. Particularly, self-control is dynamic and may change between situations and generally over time for an individual (Pratt, 2016). That is, in everyday life there can be fluctuations, lapses, or otherwise failures in self-control leading to antisocial, negative, or an overall deviation from individual normative behavior. Driven by two notable dual-process models of criminal decision-making (i.e., van Gelder, 2013; Wikström, 2004) and the ego-depletion literature within psychology, in this chapter I examined how state self-control both directly and indirectly influences criminal behavior through a dual-process model of decision-making.

Situational Action Theory and Self-control

Situational Action Theory (SAT) seeks to create a comprehensive theory of criminal behavior by incorporating individual differences alongside situational factors (for a concise introduction to SAT, see: Wikström et al., 2012). Of interest to this thesis are the concepts of the *moral context* and self-control as viewed by SAT. The moral context of a situation is determined by the perceived moral norm of a situation as well as the perceived ability for that norm to be enforced formally or informally (Wikström, 2004). In other words, the perceived moral norm of a situation may be considered the perceived consensus regarding the social acceptability or unacceptability of a given behavior. Behaviors are likely to occur when they are permissible by one's own *moral filter* (e.g., I believe it is okay to do this behavior), and do not violate the moral context of the situation (either by not violating the norm, or from a lack of enforcers).

Unlike notable previous theories of criminal behavior in which self-control is examined as a trait (e.g., Gottfredson & Hirschi, 1990), SAT suggests that self-control is best analyzed as a situational factor, particularly in relation to deterrent cues (Wikström & Treiber, 2007). Specifically, it is suggested that there is an interaction between individuals' abilities to exercise

[22]Although slight modifications have been made to promote a cohesive thesis, this chapter and resulting findings have been accepted for publication (McClanahan & van der Linden, 2020)

self-control and inhibitors of behaviors. Meaning, as state self-control decreases, to have an impact, deterrents must increase in magnitude (e.g., by becoming more likely or severe; Wikström & Treiber, 2007). That is, when state self-control is low, traditional deterrents of criminal behavior (e.g., the perceived risk of apprehension) may need to be higher than average or magnified to have the desired deterrent effect. In essence, SAT aligns with the greater literature by stating that self-control is a critical aspect of decision-making, but goes further by suggesting that state self-control may influence what type of information we use or attend to (or not) when making a decision, namely traditional deterrent cues. To provide a framework to better understand what information people may be influenced by when self-control is low — and how low self-control may directly relate to criminal behavior— I critically examined the psychological literature on ego-depletion.

State Self-control, Ego-depletion, Decision-making, and Criminal Behavior

One of the prominent theories underscoring the relationship between state self-control and variety of positive and negative outcomes posits that self-control is a limited resource that may be depleted through both single, effortful tasks as well as through repeated use over time. Therefore, performance on subsequent tasks that require self-control will be impaired (i.e., ego-depletion; Baumeister, Bratslavsky, Muraven, & Tice, 1998). The sequential task paradigm has become the primary methodology for assessing ego-depletion (Inzlicht & Schmeichel, 2012). In this paradigm, participants first complete a task requiring either high or low amounts self-control (Time 1, Group Variable). The dependent variable is then a second, unrelated task requiring participants to use their self-control once again (Time 2). Any performance difference between groups is then considered to be the result of the Time 1 task using the limited resource of self-control. [23]

Using such a paradigm, it has been observed that compared to a control group, depleted participants are less persistent in physical exercise (Dorris et al., 2012), more likely to take risks (Fischer et al., 2012), less likely to adhere to norms of reciprocity (Study Three; Gailliot, Gitter, Baker, & Baumeister, 2012), more likely to respond aggressively to provocation (Stucke & Baumeister, 2006), and in the case of law enforcement officers, more likely to use aggressive

[23]While there has been debate regarding the underling mechanism of ego-depletion (Inzlicht & Schmeichel, 2012; Reynolds & McCrea, 2016), theories centralize on the same principle tenet, that self-control can fluctuate and such fluctuations may influence behavior and decision-making.

use of force quicker against a provocateur (Staller et al., 2018). In regard to how decisions are made, depleted participants perform worse on logic and reasoning tasks, but not on general knowledge tests (Schmeichel et al., 2003). Additionally, it has been observed that participants depleted of their self-control make indistinguishable choices from participants primed to an intuitive decision-making style (Hamilton, Hong, & Chernev, 2007).

Ego-depletion may lead to maladaptive, antisocial, or criminal behavior due to the immediate hedonistic pleasure it often comprises. Specifically, unethical or criminal behavior comes with short-term rewards (e.g., immediate monetary payout) at the cost of long-term consequences (e.g., imprisonment). Self-control is therefore necessary to ignore the self-serving temptations of criminal behavior. However, once depleted, this ability diminishes and the typically controlled behavior is more likely to occur (Yam et al., 2014).[24] Indeed, studies using standard ego-depletion tasks observe that depleted participants are more likely to engage in deviant or unethical behaviors in a variety of settings (Barnes et al., 2011; Gailliot et al., 2012; Gino et al., 2011).

Collectively, the literature on ego-depletion in relation to decision-making and criminal behavior suggests that when depleted of their self-control, individuals may reduce or lose the ability to engage in deliberative decision-making and may be more likely to engage in deviant or criminal behavior.[25] In the context of criminal behavior, if depleted participants are less likely to use deliberative decision-making and therefore less likely consider traditional deterrent cues, factors that contribute to intuitive decision-making such as state emotions (e.g., Chapter One) and norms (i.e., the moral context as described by Wikström, 2004) may be driving their behavior.

For example, as negative state affect increases, criminal behavior decreases, even when controlling for individual differences in trait self-control as well as perceived risk (Pickett et

[24]Other theories have suggested a similar dynamic, but focusing on the (in)ability to recognize and navigate moral dilemmas due to depletion (Gino et al., 2011)

[25]While some studies have been less conclusive (e.g., Bouffard, 2007; Nagin & Paternoster, 1994; Piquero & Tibbetts, 1996), the observed discrepancies may be due to methodological and pragmatic limitations. For example, the literature that has examined how state self-control may influence criminal decision-making is quite limited and only now beginning to emerge, making it difficult to draw a clear consensus. Moreover, in the existing literature rarely are the methodologies exactly the same and explicitly differ regarding scenarios used to assess criminal intention and mediating variables such as shame, morality, and guilt. While such mediators are conceptually similar, they are unique in their relation with criminal behavior (Svensson, Pauwels, & Weerman, 2017).

al., 2018). Moreover, fear reduces violent criminal behavior when controlling for anger, frustration, and other known correlates of crime (Ganem, 2010). In addition to perceived risk, negative affect is also observed to mediate the relationship between trait self-control and criminal behavior (Van Gelder & De Vries, 2012, 2014). That is, as trait self-control increased, the experienced negative affect of a hypothetical criminal scenario increased, which associated with a decrease in the likelihood criminal behavior. Additionally, both perceived risk and state anger uniquely predict aggressive behavior, with the latter being positively related to aggressive behavior (Van Gelder et al., 2019). In other words, particular negative emotions have consistently been found to be considered feelings of risk, reducing criminal behavior (e.g., Slovic et al., 2004), even when controlling for traditional deterrent cues, such as perceived risk.

Conversely, while less research has examined positive state affect in relation to criminal behavior, as it is suggested that positive affect may cause individuals to overemphasize the benefits of crime (e.g., Pogarsky et al., 2018) and lead to an underestimation of risk (e.g., Johnson & Tversky, 1983), it is not without reason to suggest a positive correlation between the two (Van Gelder, 2013). For example, sexual arousal is suggested to increase sexually coercive behavior through an increase of perceived benefits (Bouffard & Miller, 2014). That is, the visceral emotion of sexual arousal not only directly increased the likelihood of using coercive tactics to obtain sex, but also indirectly through an increase in the perceived benefits of using sexually coercive tactics.

In sum, self-control in relation to criminal behavior and decision-making has been primarily assessed as a trait variable. However, when examining the greater psychological literature and newer criminological perspectives it is clear that self-control can vary over time and between situations. When considering the depletion literature, depleted participants reduce or lose the ability to engage in deliberative decision-making. As such, individuals may be primarily driven by factors indicative of intuitive decision-making such as norms and state emotions. Specifically, positive and negative emotions would promote and deter criminal behavior, respectively. Additionally, by minimizing the consideration of long-term outcomes and reducing the ability to resist temptations, depletion may directly increase criminal behavior.

The Status of the Ego-depletion Literature

It must be noted that although originally finding strong support for the theoretical foundation of ego-depletion and its sequential task paradigm (e.g., Hagger, Wood, Stiff, & Chatzisarantis, 2010), in recent years a debate has evolved questioning if ego-depletion is an accurate theory for explaining momentary lapses in self-control. Particularly, more recent meta-analyses have revealed small effect sizes for ego-depletion with confidence intervals containing zero (d = 0.04, 95%CI [-0.07, 0.15]; Hagger et al., 2016). Some have suggested the original support was inaccurate as a result of studies being underpowered due to small sample sizes (Carter et al., 2015).

However, these meta-analyses come with their own limitations. Particularly, the dependent variable used with the Hagger and colleagues' study (2016) was response time variation within the second task of the sequential task paradigm. That is, ego-depletion was measured by how long a participant took to complete a task, with longer completion times indicating depletion. If participants responded incorrectly too frequently, their data was discarded. An ego-depletion effect may have been observed as an error in a task rather than a simple delay, however this was not analyzed. Furthermore, a follow-up analysis revealed that the sequential task paradigm chosen was inaccurately implemented from the original creation (i.e., Baumeister et al., 1998) and when accounting for self-reported depletion via manipulation checks, an ego-depletion effect does exist (Dang, 2016).[26]

Additionally, it has been argued that Carter and colleagues' (2015) meta-analysis included studies that did not use actual depletion tasks and their analyses did not examine differences between depletion tasks. Following this line of reasoning, Dang (2018) reanalyzed the original data with a stricter inclusion criteria and updated results accounting for studies published between the two time periods. Dang (2018) observed that there was an overall effect for ego-depletion. However, certain tasks returned null findings (e.g., attention video), while other tasks returned greater effects (e.g., attention essay).

[26]It could be argued that since the study carried out by Hagger and colleagues' (2016) was a direct replication of an earlier ego-depletion study (Sripada et al., 2014), changing the primary dependent variable would undermine the purpose of the research. However, nothing would refrain other analyses of secondary dependent variables, as a number of differences already exist between the original and direct replication (Sripada et al., 2016). Additionally, some have attempted to argue that Baumeister himself selected the paradigm used within this study; however, Baumeister has now gone on record discrediting this claim (Baumeister, 2019).

Thus, although the ego-depletion literature and its resulting sequential task paradigm originally found large scale support, the results of recent meta-analyses have left the field contested and inconclusive. However, this should not preclude further empirical examination. Indeed, the only way to support or refute the ego-depletion literature is through further empirical analysis. Moreover, and more specific to this chapter, to my knowledge the sequential task paradigm is the only existing methodology available to reduce state self-control. Therefore, by examining the ego-depletion literature alongside criminal behavior, in this chapter I not only extend the criminological literature by experimentally manipulating state self-control in relation to criminal decision-making, but also increase the accuracy of the greater ego-depletion literature "by adding an informative, unbiased data point to the literature…to clarify the existence, size, and generality of ego depletion" (Dang et al., 2020, p. 1). Consequently, the results of this chapter may serve as guidance for future researchers that are considering ego-depletion and the sequential task paradigm in future works.

In this chapter I sought to assess what factors predict criminal decision-making when state self-control is low. Specifically, I sought to add to the criminal decision-making literature by examining: 1) what factors influence or predict criminal decision-making when state self-control is low and 2) whether depleted self-control increased criminal behavior. The latter extends to a secondary purpose of adding to the general ego-depletion literature regarding the existence of a main effect of ego-depletion.

Using a standard ego-depletion task and four criminal vignettes, I examined how indicators of two decision-making processes mediated the traditionally observed negative relationship between trait self-control and criminal decision-making (e.g., Pratt & Cullen, 2000). Adapting procedures from Van Gelder (2013), as an indicator of deliberative and intuitive decision-making, I examined perceived risk, and positive as well as negative state affect, respectively.[27] As an additional indicator of intuitive decision-making, the perceived social consensus of acceptability of a criminal behavior was assessed as a proxy for the moral context of the situation as described by SAT (Wikström, 2004). Taking the above literature into consideration, I hypothesized:

[27]Although there is debate regarding the valence of an emotion (i.e., positive versus negative) and the directionality (i.e., approach versus avoidance) in the relation to decision-making and behavior (Lerner et al., 2015), rather than assessing specific emotions that have fueled the debate, in this chapter I use the framework of the Hot/Cool model that assess general negative emotions or "feelings of risk".

H1 – Participants in the depletion group would indicate more criminal choice than the control group

H2 – Perceived risk (an indicator of deliberative decision-making) would be negatively related to criminal choice for the control group

H3 – Perceived risk (an indicator of deliberative decision-making) would *not* be a significant predictor for participants in the depletion condition

H4 – Negative state affect would negatively relate to criminal choice

H5 – Positive state affect would positively relate to criminal choice

H6 – Negative state affect and perceived risk would positively correlate

H7 – Negative and positive state affect would negatively correlate

H8 – Compared to the control group, negative and positive state affect as well as perceived social consensus of acceptability (indicators of intuitive decision-making) would be stronger predictors of criminal choice for the depletion group

Method

Participants

Participants were recruited through the online crowdsourcing platform, Prolific Academic (Peer et al., 2017). Using the average reported effect sizes (d = 0.39) of previous research (e.g., Dang, 2018a; Chow et al., 2015; Garrison et al., 2018; Yam et al., 2014) an *a priori* power analysis revealed that with an alpha of 0.05 and a power of 0.95, at least 286 participants in total would be needed to observe a main effect of ego-depletion on a subsequent task performance. To ensure sufficient power for multiple comparisons of beta-coefficients, 402 participants completed the survey. Participants were excluded from analysis if they failed to complete the depletion task successfully.

A participant was considered to 'fail' the depletion task (described below) if they did not type anything (i.e., number of characters = 0) or only typed nonsensical text (e.g., 'xxxxxxxxx'). The data quality checked revealed that 12 participants did not type any text and were excluded from analysis (Please See Appendix F; Supplementary Text 1). The final sample consisted of 390 participants ($N_{depletion}$ = 197, $N_{control}$ = 193), 51% were male and 49% were female (three participants indicated other). The average age of participants in years was 33 (*SD*

= 10). Lastly, in terms of ethnicity, approximately 85% were White, 5% were Multi-racial, 3% were Asian, 3% were Black African, or Caribbean, and 4% indicated other or preferred not to say (Table 3).

Table 3

*Sample Characteristics (*N = *390)*

Characteristic	Mean or Modal Response
N	390
Sex	51% Male
Age	*M* = 33 (*SD* = 10)
Ethnicity	Modal Response (85%) - White
Employment Status	Model Response (37%) – Full time employment
Education	Modal Response (69%) – Undergraduate or Higher
Marriage Status	Modal Response (45%) - Single

Procedure

Through an advertisement on Prolific (Appendix A, Advertisement 2), participants were invited to participate in a study on how people's attitudes and beliefs may relate to their decision-making and behaviors. Consenting participants (Appendix B, Consent Form 2) followed the link provided by Prolific to a survey on the Qualtrics Platform (Qualtrics, 2019). All participants first completed control measures of trait self-control and decision-making styles. Participants were then randomly allocated to either one of two groups, depletion or control. Upon completing their respective task, in a random presentation order, all participants completed four vignettes with a series of follow-up questions. Participants then completed standard demographic questions (e.g., sex and highest completed education level) and once finished, were debriefed (Appendix B, Debrief From 2) and paid £1.25 in compensation.

Manipulations and Measures

Self-control

As with Chapter Two, the eight-item version of the Brief Self-control Scale was used to measure trait self-control (Maloney et al., 2012; Tangney et al., 2004 α = .77, M = 23.33, SD = 5.49; please see Chapter Two for scale description and Appendix C, Set 1).

Decision-making

As with Chapter Two, the 10-item Decision-making style scale was used to measure the deliberative ($\alpha = 0.82$, $M = 20.24$, $SD = 3.12$) and intuitive ($\alpha = 0.81$, $M = 14.62$, $SD = 3.76$) decision-making styles (Hamilton et al., 2016; please see Chapter Two for scale description and Appendix C, Set 2).

Ego-depletion Task

A standard essay depletion task was used to deplete participants (e.g., Schmeichel, 2007). All participants were instructed to write about a recent trip that they had taken for approximately four minutes. Participants in the depletion group were told:

> 'Do NOT use the letters, "A" or "N" in your story! If you find yourself writing a word that includes "A" or "N", please stop writing that word and find an alternative way to express your thoughts'.

The same instructions were given to participants in the control group, but the letters 'X' and 'Y' replaced, 'A' and 'N'. As both 'A' and 'N' occur quite frequently in the English language while 'X' and 'Y' do not, it is suggested that it requires more mental resources to not use the letters 'A' or 'N' (Schmeichel, 2007). With the limited amount of mental resources being used during the writing task subsequent tasks requiring mental resources should be impaired, resulting in an ego-depletion effect.

Two follow-up questions assessing difficulty and cognitive demand on a 1 (Not at all) to 5 (Very much) scale were utilized as a manipulation check ($r = 0.68$; Appendix C, Set 5). A pilot test ($N = 40$) revealed that participants in the depletion group found the writing task significantly more difficult ($M_{depletion} = 4.40$ vs. $M_{control} = 3.30$; $t(38) = 3.35$; $M_{diff} = 1.10$, 95% CI [0.44, 1.76], Cohen's $d = 1.09$, $p = 0.002$) and cognitively demanding ($M_{depletion} = 4.30$ vs. $M_{control} = 3.15$; $t(38) = 4.04$; $M_{diff} = 1.15$, 95% CI [0.57, 1.73], Cohen's $d = 1.31$, $p < 0.001$).[28] However, a technical difficulty required the manipulation to be amended so the survey would automatically continue after four minutes had passed (see Appendix F, Supplementary Text S2 for a detailed description).

[28]Data from the pilot-test was not included in the final analysis presented in text.

Vignettes

The outcome variable of criminal choice and mediating variables were assessed by having participants read four hypothetical scenarios and answer questions following each. Before the presentation of the scenarios, participants were told that they were going to be presented with a dilemma and were to answer a series of questions following each. The chosen scenarios have been used in previous research assessing the relationship between decision-making and individual differences in relation to illegal behavior (e.g., Fine et al., 2016; Van Gelder & De Vries, 2014). For example, a scenario involving petty theft read as:

> You are at a convenience store after a long day of work. You haven't eaten since the morning because your manager kept you working through lunch. This is your one chance to buy food before you start the night shift at your second job. You are about to purchase a snack when you realize you don't have enough money to buy anything. However, you could slip the snack into your pocket and walk out the door.

Other scenarios included illegal downloading, illegal streaming, and buying stolen goods (Appendix D, Supplementary Table S3). To control for order-effects, all scenarios were presented in a random order. Additionally, excluding criminal choice (which always appeared first) and perceived social consensus (which always appeared last), to reduce priming biases, the remaining follow-up questions were also randomly presented.

Criminal Choice

Three follow-up questions after each vignette were used to assess criminal choice. The first item asked participants to indicate the likelihood of engaging in the criminal option on a 1 (Extremely Unlikely) to 7 (Extremely Likely) scale. The second item assessed how certain the participant was about their perceived likelihood of engaging in the criminal option on a 1 (Entirely Uncertain) to 7 (Entirely Certain) scale. The third item was a percentage estimate item assessing the likelihood of engaging in the criminal choice (i.e., 0-100%; Appendix C, Set 6). Following previous research (Van Gelder & De Vries, 2012, 2014), the first item assessing likelihood was recoded to range from -3 to +3 and multiplied by the certainty item to create a new variable ranging from -21 to +21. To create a single variable of criminal choice, both the new variable along with the percentage estimate item in each vignette were converted into z-scores and summed (r = 0.88, see Supplementary

Figure S8 in Appendix E for a histograms and distribution statistics). The recoding of the variables and their standardization allow for more granularity within a variable that is regularly observed to hold a skewed distribution towards zero (i.e., most participants indicate little to no criminal behavior, violating assumptions of most analyses).

Negative and Positive State Affect

As an indicator of intuitive decision-making, negative and positive state affect were measured by five items each, per vignette. Participants read the sentence, 'Would this situation make you feel…?' and were presented a series of affective variables including: insecure, frightened, worried, nervous, negative feelings in general, excited, relieved, thrilled, calm, and positive feelings in general. Participants indicated how much the situation made them feel each affective variable on a 1 (Not at all) to 7 (Very much) scale. To reduce priming, the presentation of negative and positive words was randomized. In total, 20 negative state affect items (α = 0.91, M = 79.55, SD = 21.08) and 20 positive state affect items (α = 0.89, M = 62.23, SD = 18.72) were collected (Appendix C, Set 7).[29]

Perceived Risk

Following previous research (e.g., Nagin & Paternoster, 1993), as an indicator of state deliberative decision-making and traditional rational choice variables, measures of perceived sanction probability and severity were used to create a multiplicative variable of perceived risk. Two items per vignette (eight in total) measuring the perceived likelihood of sanction were measured on a 1 (Very Unlikely) to 7 (Very Likely) scale and asked, 'How likely is it that you will be caught if you…' and 'What are the chances that you will be found out if you…' (α = 0.81, M = 25.97, SD = 8.59).

Two items per vignette (eight in total) measuring the perceived severity of sanction were measured on a 1 (Not Severe [annoying] at all) to 7 (Very Severe [annoying]) scale and asked, 'How severe do you consider the possible consequences of being caught to be?' and 'How annoying do you find the potential negative consequences of being caught to be?' (α =

[29] The descriptive statistics here are for the summative form of each construct across all four scenarios (e.g., adding all 20 positive affect variables together and taking the average of the total score).

0.72, *M* = 34.05, *SD* = 8.56). The two perceived likelihood and severity items were individually summed and then multiplied together to create a single perceived risk variable for each vignette (α = 0.67, *M* = 241.34, *SD* = 113.56; Appendix C, Set 8).

Social Consensus

A single question asking, 'What percentage of people do you think find … to be acceptable behavior' was presented after each vignette (α = 0.63, *M* = 233.53, *SD* = 57.83; Appendix C, Set 9). Participants indicated their perceived social consensus of acceptability on a 0% (No one finds this behavior acceptable) to 100% (Most, if not all, find this behavior acceptable) scale. A third label was aligned with the 50% mark of the scale that stated, 'It is not clear how acceptable this behavior is in society'.

Results

Group Comparison and Manipulation checks

To ensure groups were not significantly different on key variables of interest before manipulation, between-groups analyses were conducted.[30] As indicated in Table 4, groups did not significantly differ regarding trait self-control nor decision-making styles. Manipulation checks were significantly positively correlated (r = 0.68, p < 0.001). As such, they were summed to create a single item for analysis. Suggesting that the essay writing task successfully depleted participants, participants in the depletion group found the task more difficult ($M_{depletion}$ = 8.67 vs. $M_{control}$ = 5.67; $t(366.38) = 15.95$; M_{diff} = 3.00, 95% CI [2.63, 3.37], Cohen's d = 1.62, 95% CI [1.39, 1.85], p < 0.001; Table 4, Figure 2).

[30]Tests of Normality and Homogeneity of Variance may be found in Appendix D, Supplementary Table S4.

Table 4

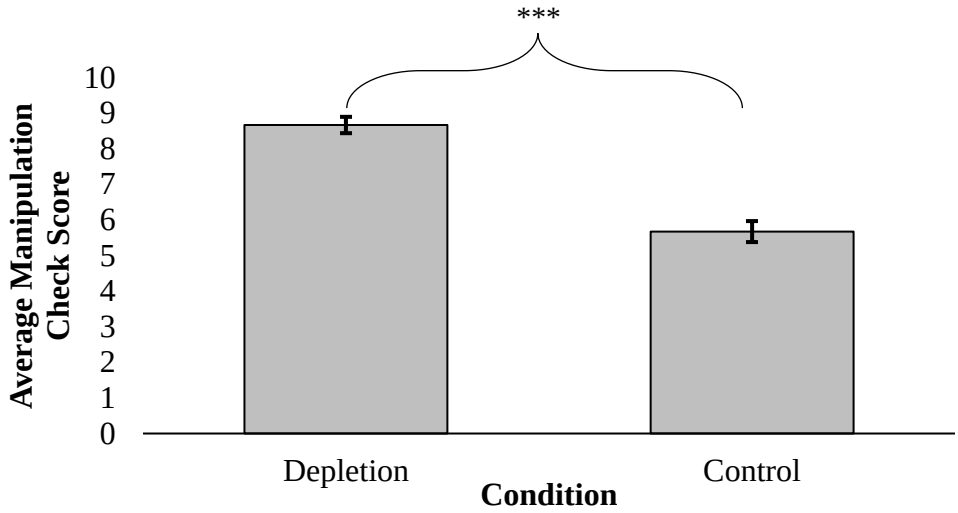
Group Comparison and Manipulation Check

Construct	Depletion $N = 197$	Control $N = 193$	Significance
	M (*SD*)	*M* (*SD*)	
Trait Self-control	23.23 (5.39)	23.44 (5.59)	$t(388) = -0.38$, $p = 0.70$
Intuitive Decision-making	14.44 (3.77)	14.79 (3.75)	$t(388) = -0.92$, $p = 0.36$
Deliberative Decision-making	20.21 (2.93)	20.27 (3.31)	$Z = -0.42$, $p = 0.68$
Manipulation Check Index	8.67 (1.62)	5.67 (2.06)	$t(366.38) = 15.95$, $p < 0.001$ $Z = 12.97$, $p < 0.001$

Notes: As deliberative decision-making was non-normally distributed a Mann-Whitney test was conducted. The manipulation check index was non-normally distributed and violated the assumption of homogeneity of variance, as such we report both a Mann-Whitney test as well as a Welch's *t*-test of unequal variance.

Figure 2

Average Manipulation Check Scores by Condition



Note. Higher scores indicate a greater ego-depletion effect as measured by the two manipulation check questions (Appendix C, Set 5) . Error bars represent exact 95% CIs.

Descriptive statistics for each construct are provided in Table 5. Lending initial support to Hypotheses 2 and 3, in the control group perceived risk was significantly correlated with criminal choice ($r = -0.49$, $p < 0.001$), but not in the depletion group ($r = -0.09$, $p = 0.207$). Using Fisher's Z-transformation, compared to the depletion group, the correlation between perceived risk and criminal choice was significantly greater in magnitude in the control group

($Z = 4.378$, $p < 0.001$).[31] Conversely, negative and positive state affect as well as perceived social consensus held significant relationships with criminal choice in both groups with no significant difference in magnitude ($Z_{negative} = 1.06$, $p = 0.29$; $Z_{positive} = 0.54$, $p = 0.59$; $Z_{consensus} = -0.99$, $p = 0.32$).

[31]Fisher's Z transformation and comparison was computed using the 'cortesti' package in Stata (Caci, 2000)

Table 5

*Correlation Matrix and Descriptives for Depletion and Control group (*N *=197, 193)*

	Criminal Choice	Perceived Risk	Negative State Affect	Positive State Affect	Trait Self-control	Social Consensus	Deliberative	Intuitive
Criminal Choice	-	**-.49*** **	-.63***	.66***	-.25***	.38***	-.19**	.10
Perceived Risk	**-.09**	-	.58***	-.24***	.11	-.10	.00	.18**
Negative State Affect	-.56***	.44***	-	-.36***	.16*	-.24**	.14*	.06
Positive State Affect	.69***	.08	-.41***	-	-.14*	.26***	-.14*	.18**
Trait Self-control	-.23**	.13	.12	-.01	-	-.10	.35***	-.07
Social Consensus	.29***	.10	.01	.15*	-.14*	-	.00	.12
Deliberative	-.19**	.11	.17*	-.18**	.21**	.00	-	-.37***
Intuitive	.10	.17*	.12	.09	-.03	.09	-.31***	-
Mean (SD)	.02 (1.92)	238.81 (111.78)	79.46 (19.86)	62.06 (19.62)	23.23 (5.39)	239.38 (56.22)	20.21 (2.93)	14.44 (3.77)
Mean (SD)	-.02 (1.98)	243.93 (115.58)	79.64 (22.31)	62.40 (17.80)	23.34 (5.59)	227.57 (58.98)	20.27 (3.31)	14.79 (3.75)

Notes: The depletion group's correlation matrix runs below the diagonal line in the greyscale. Significant differences of hypothesized associations between groups are bolded

* $p < .05$; ** $p < .01$; *** $p < .001$

State Self-control and Criminal Choice

To test the hypothesis that ego-depletion reduces state self-control, which in turn increases criminal choice, a between groups analysis was conducted (Hypothesis 1). A *t*-test revealed there to be no significant difference between the depletion and control group regarding criminal choice ($M_{depletion}$ = 0.02 vs. $M_{control}$ = -0.02 $t(388) = 0.1958$, M_{diff} = 0.04, 95%CI [-0.35, 0.43], Cohen's d = .02, 95% CI [-0.18, .22], p = 0.8448).[32]

Differences in Mediating Variables and their Relationship with Criminal Choice

Structural Equation Modeling (SEM) was used to examine how the relationship between mediators and criminal choice would differ between groups. Before estimation, to reduce unique variance and model complexity, parceling techniques were used. Specifically, as a general model (rather than crime specific) was sought and in an effort to reduce error variance, in accordance with previous research (Fine et al., 2016; e.g., Nagin & Paternoster, 1993; Van Gelder & De Vries, 2012, 2014) all variables were indexed across the four vignettes.[33] Following Van Gelder and De Vries (2014) all percentage estimates of criminal choice were combined into a single observed indicator and all multiplicative outputs of criminal choice into another single indicator (see methods section). Additionally, the item-to-construct parceling technique was utilized to parcel all mediators (Coffman & MacCallum, 2005; Little et al., 2002, 2013). As with Chapter Two, as the trait self-control measure assess two dimensions (i.e., restraint and impulsivity) the domain-representative parceling technique was chosen (Kishton & Widaman, 1994).[34]

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[32]The checked assumptions for the reported t-test may be found in Appendix D, Supplementary Table S4; Appendix E, Supplementary Figure S8.

[33] In accordance with previous research (Van Gelder & De Vries, 2014), to ensure compatibility, the same constructs from each scenario were correlated with one another. All correlations were significant ($p < 0.05$) ranging from 0.20 to 0.68. Additionally, although the alpha for the individual items summed are reported in text, the alphas for constructs between scenarios was acceptable, ranging from 0.60 to 0.76. Finally, all predictor variables correlated with the outcome variable of criminal choice in a similar manner across scenarios. Specifically, risk and negative affect were significantly negatively correlated with criminal choice while positive affect and perceived social consensus of acceptability were significantly positively associated with criminal choice in all scenarios.

[34]Factor loadings for parceling were derived from a full model (i.e., all items as single observed indicators leading to their respective latent factor). All latent factors were allowed to freely correlate and all factors were set to be constrained across both groups (χ^2 (4081) = 13786.962, RMSEA = 0.11 95% CI [0.11, 0.12], CFI = 0.46, TLI = 0.46, SRMR = 0.15; Appendix E, Supplementary Figure S10; Appendix F, Supplementary Text S3).

When comparing path coefficients between groups it is important to first establish that the mean levels of the variables of interest (either as latent or observed construct) do not significantly differ, and to determine the model's level of invariance. Ensuring that the latent variable means as well as at minimum measurement loadings are not significantly different between groups allows meaningful conclusions to be drawn. To accomplish this, the general protocol for assessing model invariance and latent variable means by using CFA to compare the fit of a series of models from least to most constrained was followed (e.g., Acock, 2013). Using the parceled model described above, as with Chapter Two all latent variables of interest were allowed to freely correlate with one another and the models were estimated using maximum likelihood with no missing data. Model fit was assessed utilizing common thresholds of 0.08 for RMSEA, 0.08 for the SRMR, and 0.95 for the CFI and the TLI (e.g., Kline, 2005).

The following models were compared in regard to significant decreases in model fit, signified by likelihood-ratio test of the χ^2 for each model as well as general change in the other fit statistics: Model 1) an unconstrained model, Model 2) measurement loadings were constrained to be equal across groups, Model 3) measurement loadings and intercepts were constrained to be equal across groups, Model 4) measurement loadings, intercepts, and variances were constrained to be equal across groups, Model 5) measurement loadings, intercepts, variances, and covariances were constrained to be equal (Table 6).

Table 6

CFA Invariance Testing Between Depletion and Control Groups

Model	**χ^2 (*df*)**	**χ^2 diff.**		**RMSEA (90%CI)**	**CFI**	**SRMR**
1	(78) = 205.503 <0.001	-	-	0.09 (0.08 , 0.11)	0.96	0.04
2	(84) = 211.942 <0.001	2 vs 1	(6) = 6.44 *p* = 0.3758	0.09 (0.07 , 0.10)	0.96	0.04
3	(96) = 228.428 <0.001	3 vs 2	(12) = 6.98 *p = 0*.8589	0.08 (0.07 , 0.10)	0.96	0.04
4	**(108) = 235.355 <0.001**	**4 vs 3**	**(12) = 16.43 *p* = 0.1722**	**0.08 (0.06 , 0.09)**	**0.96**	**0.04**
5	(129) = 274.623 <0.001	5 vs 4	(21) = 29.27 *p* = .01**	0.08 (0.06, 0.09)	0.95	0.08

Notes: Each successive model increases in the number of constraints. The bolded model is the most constrained model without a significant decrease in model fit. There were no factor variances to be constrained.

* $p < .05$; ** $p < .01$; *** $p < .001$

To draw meaningful conclusions between models, the most restrictive model without reporting significantly worse fit than the last model should always be used (Acock, 2013). As such, Model 4, in which measurement loadings, variances, and intercepts are constrained was used for all testing. Measurement loadings for each construct in this model are all significant ($p < .001$; Appendix E, Supplementary Figure S11). Although Model 5 was more restrictive, constraining covariances between the latent variables to be equal across groups significantly reduced fit. This indicates that participants in different groups do not significantly differ in regard to how they interpret and answer the questions, but how the variables relate to one another does differ.

Finally, using Model 4, to assess latent means, I constrained the depletion group's mean on each latent variable to be zero as a reference. This allowed for the control group's mean to be determined and examined for potential group differences. There was no significant difference in the means of the latent variables between groups regarding criminal choice ($p = 0.878$), trait self-control ($p = 0.225$), perceived risk ($p = 0.709$), social consensus ($p = 0.148$), negative affect ($p = 0.866$), nor positive affect ($p = 0.865$). Considering the above, it is reasonable to conclude that any observed differences in path coefficients in an SEM is likely due to how the parameters vary amongst one another and not due to mean or measurement differences between groups.

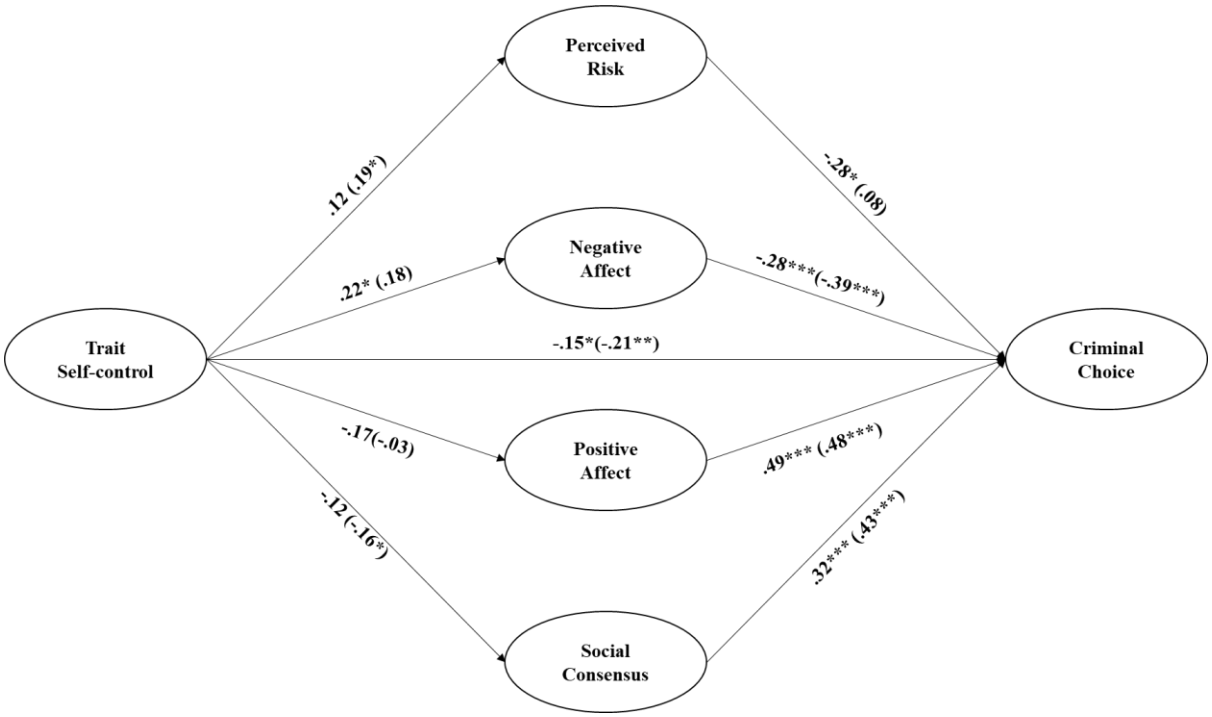
An SEM in which the mediators were allowed to freely correlate while constraining measurement loadings, intercepts, and variances across groups demonstrated a good fit to the data (χ^2 (108) = 235.355 $p < 0.001$; RMSEA = 0.08 90%CI [0.06, 0.09]; CFI = 0.96; SRMR = 0.04).[35] As displayed in Figure 3 and 4 and in support of Hypotheses 2 and 3, risk is significantly associated with criminal choice in the control group ($\beta = -0.28$, 95% CI [-0.51, -0.05], $p = 0.019$) but not in the depletion group ($\beta = 0.08$, 95% CI [-0.14, 0.30], $p = 0.465$). Supporting Hypotheses 5 and 4, positive affect was positively related to criminal choice in both groups ($\beta_{control} = 0.49$, 95% CI [0.38, 0.60], $p < 0.001$, $\beta_{depletion} = 0.48$, 95% CI [0.36, 0.60], $p < 0.001$), and negative affect was negatively related to criminal choice in both groups ($\beta_{control} = -0.28$, 95% CI [-0.42, -0.14], $p < 0.001$, $\beta_{depletion} = -0.39$, 95% CI [-0.55, -0.22], $p < 0.001$).

[35]As there are no latent error terms within a CFA, I was unable to establish this level of strict invariance to be tested in a fully structural model and thus is not reported in text. However, for comparison, a model in which all latent errors were constrained to be equal across groups was compared to the model presented in text, and while returning very similar estimates, had significantly worse fit (Appendix D, Supplementary Table S5)

Moreover, perceived social consensus was positively related to criminal choice in both groups ($\beta_{control}$ = 0.32, 95% CI [0.15, 0.49], p < 0.001, $\beta_{depletion}$ = 0.43, 95% CI [0.23, 0.63], p < .001).

Figure 3

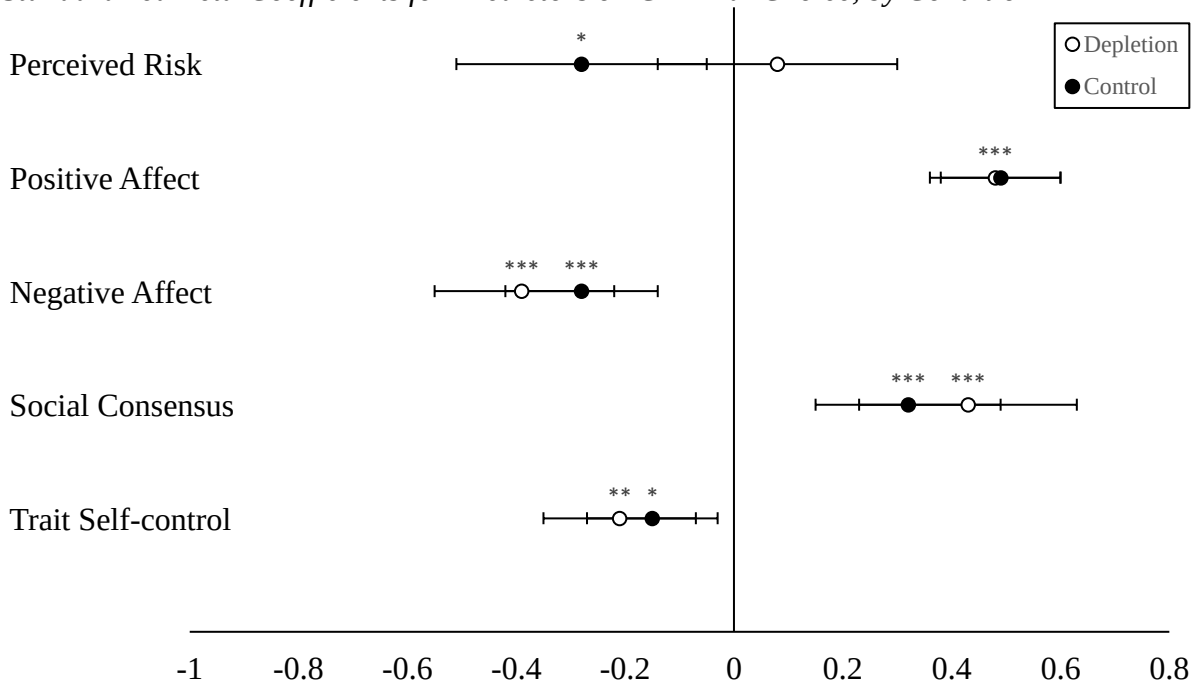
Between Groups Mediation Model of Perceived Risk, Negative Affect, Positive Affect, and Social Consensus on Criminal Choice



Notes. The depletion group's coefficients are presented in the parentheses. Coefficients are standardized. Although not presented, observed indicators, measurement error terms, and correlations may be found in the full model (Appendix E, Supplementary Figure S12). Model fit: χ^2 (108) = 235.355, p <.001; RMSEA = .08, 90% CI [.06, .09]; CFI = .96; SRMR = .04; $R^2_{criminal\ choice}$ = 0.75 (Control); 0.72(Depletion). * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Figure 4

Standardized Beta-Coefficients for Predictors on Criminal Choice, by Condition



Note. Error bars represent exact 95% CIs. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

To test the difference in magnitude of influence, an amended multiverse statistical approach was taken in which two statistical tests were used to compare the beta-coefficients of the predictors by group, specifically positive affect, negative affect, and perceived risk (Steegen et al., 2016). First, using a likelihood-ratio test the main model is compared to four models in which the path from: 1) perceived risk, 2) negative affect, 3) positive affect, and 4) perceived social consensus to criminal choice is constrained to be equal across groups. A significant difference between a constrained model and the unconstrained model would indicate the model performs worse when forcing the path to be equal across groups.[36] As can be seen in Table 7, constraining the path from risk to criminal choice to be equal between groups significantly reduces the model's fit, particularly in regard to the χ^2 statistic.[37] Conversely, constraining the paths between the affect variables and perceived social consensus did not return a model with a significantly worse fit.

[36]Unconstrained in this context refers to Model 4 in Table 6 in which the measurement path coefficients, all measurement error, loadings, and intercepts are constrained.

[37]When constraining the path to be equal across groups the relationship is non-significant ($\beta_{constrained} = 0.09$, 95% CI [-0.26, 0.07], $p = 0.260$).

Table 7

Comparison of Models with and without Path Constraints on Risk to Criminal Choice

Model	χ^2 (*df*)	χ^2 diff.	RMSEA (90%CI)	CFI	SRMR
Main	(108) = 235.355 $p < 0.001$	-	0.08 (0.06 , 0.09)	0.96	0.04
Risk	(109) = 240.227 $p < 0.001$	(1) = 4.92 $p = 0.03$	0.08 (0.07 , 0.09)	0.96	0.04
Negative	(109) = 236.305 $p < 0.001$	(1) = 0.95 $p = 0.33$	0.08 (0.06, 0.09)	0.96	0.04
Positive	(109) = 235.381 $p < 0.001$	(1) = 0.03 $p = 0.87$	0.08 (0.06, 0.09)	0.96	0.04
Social	(109) = 236.095 $p < 0.001$	(1) = 0.74 $p = 0.39$	0.08 (0.06, 0.09)	0.96	0.04

Notes: The model labeled main is the model presented in text while all other models have the additional constraint of the respective path coefficient to criminal choice. All models are compared to the main model. As the models in which the paths from negative affect, positive affect, and perceived social consensus to criminal choice did not perform significantly worse than the main model, an additional model in which all three paths were constrained was ran and returned very similar estimates to the main model (Appendix E, Supplementary Figure S13; χ^2 (111) = 237.547, $p < 0.001$; RMSEA = .08, 90% CI [.06, .09]; CFI = .96; SRMR = .04; $R^2_{\text{criminal choice}}$ = 0.75 (Control); 0.70 (Depletion).

Secondly, I used the formula from Paternoster, Brame, Mazerolle, and Piquero (1998) to assess the equality of regression coefficients. In this method, the unstandardized beta coefficients and standard errors are used to determine a Z-score with the relative *p*-value indicating significant differences. As can be seen in Table 8, the magnitude of the perceived risk coefficients are significantly different from one another, but no other differences were observed for the affect variables or perceived social consensus. Thus, I find support for the notion that risk is a negative predictor in the control group (Hypothesis 2) but not in the depletion group (Hypothesis 3). However, there is no difference between groups in regard to perceived social consensus, positive state affect, nor negative state affect. As such, there is no support for the notion that affective and normative variables are *more* influential for participants in the depletion group (Hypothesis 8).

Table 8

Differences in Magnitude of Predictors by Group

Predictor	Formula	*Z* (*p*)
Risk	$\frac{(.009544)-(-.0031806)}{\sqrt{(.0013075)^2+(.0013977)^2}}$	2.16 (0.030)
Social	$\frac{(.0031446)-(.0097629)}{\sqrt{(.0031446)^2+(.002694)^2}}$	0.81 (0.418)
Negative Affect	$\frac{(-.0357331)-(-.0258564)}{\sqrt{(.00777)^2+(.006665)^2}}$	-0.96 (0.337)
Positive Affect	$\frac{(.0501694)-(.0515268)}{\sqrt{(.0065282)^2+(.0057754)^2}}$	-0.16 (0.873)

Notes: b_1 and its corresponding standard error was always the depletion group, while b_2 and its corresponding standard error was always the control group.

All z-scores were determined using: $Z = \frac{b_1-b_2}{\sqrt{SEb_1^2+SEb_2^2}}$

Trait self-control was significantly related to some mediators for the depletion group, and others for the control group; however, no consistent trend was observed. For example, in the control group trait self-control held a significant positive relationship with state negative affect ($\beta_{control}$ = 0.22, 95% CI [0.01, 0.42], p = 0.04), but not in the depletion group (p = 0.08). Conversely, in the depletion group trait self-control was significantly related to both perceived risk ($\beta_{depletion}$ = 0.19, 95% CI [0.02, 0.36], p = 0.03) and social consensus ($\beta_{depletion}$ = -0.16, 95% CI [-0.30, -0.01], p = 0.03). Trait self-control was not significantly related to positive affect in either group ($p_{control}$ = 0.07, $p_{depletion}$ = 0.79). Trait self-control held a significant negative association with criminal choice in both conditions ($\beta_{control}$ = -0.15, 95% CI [-0.27, -0.03], p = 0.01; $\beta_{depletion}$ = -0.21, 95% CI [-0.35, -0.07], p = 0.003). Mediation analysis revealed that trait self-control had a significant indirect negative effect on criminal choice in the control group ($\beta_{control}$ = -0.22, 95% CI [-0.38, -0.05], p = 0.01), but not in the depletion group ($\beta_{depletion}$ = -0.14, 95% CI [-0.32, 0.04], p = 0.14). The majority of the indirect effect observed in the control group was through state positive affect (36%).[38]

In both conditions, perceived risk and social consensus were not significantly correlated $p_{depletion}$ = 0.09, $p_{control}$ = 0.25). In support of Hypotheses 6 and 7, in both groups perceived risk

[38]The unique contributions of mediation by each mediator can be found in Appendix D, Supplementary Table 6

and negative affect were significantly positively correlated ($r_{depletion}$ = 0.29, 95% CI [0.17, 0.40], $p < 0.001$, $r_{control}$ = 0.44 95% CI [0.29, 0.58], $p < 0.001$) and negative and positive affect were significantly negatively correlated ($r_{depletion}$ = -0.43, 95% CI [-0.58, -0.28] $p < 0.001$, $r_{control}$ = -0.35, 95% CI [-0.50, -0.20], $p < 0.001$). Perceived risk and positive affect as well as social consensus and negative affect were significantly negatively correlated in the control group ($r_{control}$ = -0.15, 95% CI [-0.26, -0.05], p = 0.01; $r_{control}$ = -0.14, 95% CI [-0.25, -0.02], p = 0.02, respectively) but not in the depletion group ($p_{depletion}$ = 0.33, $p_{depletion}$ = 0.67, respectively). Finally, social consensus and positive affect were significantly positively correlated in the control group ($r_{control}$ = 0.15, 95% CI [0.05, 0.26], p = 0.004), but not the depletion group ($p_{depletion}$ = 0.09).

To summarize, the analyses revealed that there was no between-group differences regarding the amount of criminal choice neither as a raw value or estimated latent mean. However, risk was only a significant predictor for participants in the control group. Particularly, there was a negative relationship between perceived risk and criminal choice within the control group which was not observed in the depletion group. This was demonstrated by the significant difference in magnitude both as bivariate correlation and path coefficients in a SEM with measurement variances, loadings, and intercepts constrained. Furthermore, model fit was reduced when constraining this path to be equal across groups. Thus, while state self-control may not influence the amount of criminal choice, it may influence what factors predict it – namely traditional deterrent factors such as perceived risk.

Conversely, both positive state affect and perceived social consensus around acceptability were positively associated with criminal choice in both groups. Additionally, negative state affect was observed to negatively associate with criminal choice in both groups. Moreover, there was no significant difference between groups regarding the magnitude of the relationship between the affect nor social consensus variables and criminal choice.

Discussion

Inspired by a dual-process framework, in this chapter I used a standard ego-depletion task to examine how state self-control influences indicators of two decision-making processes in relation to criminal decision-making. The overall results yielded mixed results for the hypotheses. Specifically, there was no difference in criminal choice between participants in the

control and depletion group, as such null Hypothesis 1 is retained. It could be argued that the reason that a main effect was not detected was because the depletion task was not extensive enough. While a number of ego-depletion tasks exist and therefore could be used, one that could easily be implemented in an online setting with the greatest effect size compared to other methods was the standard essay task (e.g., Dang, 2018; Schmeichel, 2007). Moreover, the manipulation checks indicated a successful depletion. Finally, the duration of an ego depletion task only accounts for a small amount of variation in the effect size of ego-depletion (e.g., Hagger et al., 2010).

The inability to detect a main effect may be due to the fact that it does not exist in a laboratory setting, or at least to the degree that has been traditionally suggested. Although continually debated, in a multi-lab study (N = 1,775) it was recently suggested that the true main effect may range between d = 0.10 and 0.16 (Dang et al., 2020). To detect an effect of this size, a sample between 615 and 1,571 participants *per condition*, would be required. As such, the study presented here could be considered underpowered with the newly suggested effect size. Going forward, researchers using a sequential task paradigm should consider a multi-lab approach to allow for higher sample sizes and the detection of smaller effect sizes.[39]

Similarly, the inability to detect a difference in criminal choice may be due to a potential limit on the generalizability of the ego-depletion literature to the context of criminal behavior. Studies that observe that ego-depletion increases antisocial behavior use outcome variables that: 1) may be considered less aggressive or anti-social than definitive criminal behavior, 2) are more anonymous, and 3) without any potential repercussions to the participant (hypothetical or real). Common measures of antisocial responses in ego-depletion studies include an anonymous evaluation of the experimenter, in which negative evaluations are considered more aggressive (e.g., Stucke & Baumeister, 2006), the amount of hot sauce applied to chips given to confederate participants that claimed to not like spicy foods (DeWall et al., 2007, Experiment 1), and loudness and duration of blasts of white noise to confederates (DeWall et al., 2007, Experiment 2). Importantly, this research highlights that provocation by the confederate who would receive the negative behavior (e.g., the negative evaluation or spicy chips) is an important moderator of the ego-depletion antisocial behavior relationship (DeWall

[39]The most recent study from Dang et al. (2020) was not available at the time of study design and implementation for this doctoral thesis

et al., 2007). As such, the inability to detect a difference between groups could also be due to a lack of provocation by a third party eliciting a certain behavior, or due to being a more explicit measure of antisocial behavior than traditionally assessed in a laboratory setting. Future research may investigate the former by using a 2 (Depletion vs. Control) x 2 (Provocation vs. No-provocation) vignette design.

Finally, the inability to observe a main effect may be due to a combination of habit formation, moral guidance, and vignette design. Specifically, self-control is positively related to habitual formation (e.g., de Ridder et al., 2012; Gillebaart & de Ridder, 2015). That is, through initial effortful processing and repeated exposure, higher levels of trait self-control increase the probability of creating habits and prototypical responses. Highly internalized moral standards or habits related to criminal behavior may not require effortful processing or large amounts of self-control (Gino et al., 2011). By measuring low-level criminal behavior that most participants may have a fair amount of exposure to (e.g., illegal streaming) or a prototypical response to (e.g., I would never steal), the ability to detect a difference between participants may have been reduced.

That is, as depleted participants are more likely to make a decision using their intuitive system, and therefore follow habits, exposing them to familiar scenarios that they may have a prototypical response may be unlikely to elicit the self-serving and immediate antisocial or criminal response hypothesized by theory. Instead, such a paradigm may elicit the habitual response that individuals develop over time. This extends to participants in the control condition as well. As indicated by the control measures, participants in the control and depletion groups did not differ regarding trait self-control nor decision-making styles. Moreover, on average humans are suggested to be guided more by their intuitive system rather than constant deliberation (Kahneman, 2003, 2011). Therefore, it is possible that participants in the control group were just as likely to respond to the vignettes using habit or prototypical responses. To summarize, one potential reason an ego-depletion effect was not found may be due to prototypical, morally grounded, responses held by participants that do not require self-control or executive functioning to exhibit, and thus depletion would return a null-effect.

While potentially reducing ecological validity, had I used a measure of criminal decision-making that did not use everyday scenarios that participants were likely to be familiar with (and therefore not have a habitual response to), or something more ambiguous as

traditionally used in the ego-depletion literature discussed above, an effect may have been observed. Specifically, depleted participants may have chosen more immediate self-serving criminal alternatives than control participants. Moreover, had participants' moral standards in regard to low-level criminal behavior been controlled for, a moderation effect in which there was an ego-depletion effect for people with low moral standards but not for people with high moral standards may have been observed.

Regarding the relationship between risk and criminal choice as a function of state self-control, the analyses indicated that while both perceived risk and criminal choice have similar meanings between participants, how both variables relate to one another differs. Particularly, perceived risk held a significant negative association with criminal choice in the control group and held no significant relationship with criminal choice in the depletion group, neither as a bi-variate correlation nor path coefficient. Moreover, the perceived risk to criminal choice path was significantly different in magnitude between group and constraining this path to be equal across groups reduces model fit. Collectively, these findings allow for the rejection of null Hypotheses 2 and 3.

There are two ways to interpret this result. First, as suggested by Wikström and Treiber (2007), state self-control influences what information is attended to when deliberating. That is, when state self-control is low, individuals are less likely to consider the cognitive risks of crime traditionally associated with deterrence theory (e.g., risk of apprehension). On the other hand, one could argue that state self-control influences what decision-making process is used. For example, by priming participants to intuitive decision-making, negative affect but not risk, has been observed to significantly relate to criminal choice (Van Gelder & De Vries, 2014). Considering the larger self-control literature, lower state self-control may increase the reliance on internal or moral norms and heuristics, and therefore reduce the need for deliberation, rather than omit it as a possibility. Regardless, this distinction is perhaps unnecessary and goes against prominent dual-process theories, including SAT and the Hot/Cool framework which both suggest that the use of one decision-making system does not prevent the use of the other, and individuals may drift back and forth between the two. The results of this study suggests that state self-control may influence this drift, and therefore influence what information is used when making a decision.

Conversely, there was no significant difference between groups regarding both positive and negative affect nor perceived social consensus in relation to criminal behavior. As such, null Hypothesis 8 is retained.[40] By depleting participants of their mental resources I may have only decreased the influence of cognitive factors, such as risk perception, and may not have necessarily increased the influence of affective and normative factors. Furthermore, by not using a manipulation to increase reliance on cognitive factors in the control group, emotions and normative factors may have been just as influential for both groups. In a similar vein in regard to the rest of the discussion, as individuals are more likely to be naturally be driven by their intuitive decision-making (Kahneman, 2003, 2011), it is possible that both groups of participants were just as likely to be influenced by the perceived social consensus and affective variables. Thus, the non-significant difference in affect variables may be the result of a lack of polarization. Had a third group been included that was manipulated in a manner to increase the influence of emotions, such as increasing empathy (e.g., Bal & Veltkamp, 2013), or if perceived social consensus was manipulated by experimentally manipulating normative information (e.g., Terry et al., 2000), I may have polarized groups more and observed the hypothesized differences.

Nonetheless, in accordance with previous research (e.g., Van Gelder & De Vries, 2012, 2014) negative affect was negatively related to criminal choice in both groups ($\beta_{control}$ = -0.28, $\beta_{depletion}$ = -0.39) and held a positive correlation with perceived risk in both groups ($r_{depletion}$ = 0.29, $r_{control}$ = 0.44). This lends additional support to the notion that negative affect uniquely predicts criminal decision-making. Moreover, in both groups positive affect positively related to criminal choice ($\beta_{control}$ = 0.49, $\beta_{depletion}$ = 0.48) and negatively correlated with negative affect ($r_{depletion}$ = -0.43 $r_{control}$ = -0.35).

Researchers have highlighted the need to compare the relative importance of both negative "push" emotions and positive "pull" emotions alongside perceived risk in relation to criminal choice (Van Gelder & De Vries, 2016). When comparing the coefficients of the affect variables and perceived risk in relation to criminal choice in the control group (Appendix D,

[40]As indicated in Chapter One, affect may both directly influence our decision-making by acting as an indicator to behave in a particular way (e.g., *feelings of risk*, affect-as-information; Clore et al., 2001) as well as indirectly by influencing how we process information (Gasper & Clore, 2002). How affect influences decision-making will depend on a number of factors (Forgas, 1995). As I assessed specific feelings in regard to specific stimuli (i.e., negative and positive feelings about four criminal vignettes), I believe the affect elicited in this chapter is best illustrated as an *emotion*, rather than a *mood*, and thus more likely to have acted as information (Clore et al., 2001) rather than influencing how information was processed, though this possibility cannot be excluded.

Supplementary Table S7), positive affect has the greatest magnitude, followed by negative affect, and then perceived risk.[41] Thus, even when state self-control is presumed to be 'normal', affective components, particularly positive "pull/lure" emotions appear to be most influential.

Finally, in congruence with previous research (Van Gelder & De Vries, 2014) self-control held a significant negative relation to criminal choice in both conditions and held a significant indirect effect in the control condition (Appendix D, Supplementary Table 6). However, there was no consistent between-group trend regarding trait self-control in relation to the mediators. For example, had it been found that trait self-control did not associate with any of the mediators nor criminal choice in the depletion group, this would suggest that self-control, while a critical factor, may be best examined as a state variable as described by SAT (Wikström & Treiber, 2007). However, trait self-control was significantly negatively related to criminal choice in both groups, and while inconsistent, did relate to some mediators in both groups. Thus, caution should be taken when deciding to omit it as a trait variable and it should continue to be controlled for in future work. As individuals differ in their susceptibility to self-control variation over time and situations (Baumeister et al., 2019; Pratt, 2016), future research examining ego-depletion should ensure to also control for trait self-control as I have done here.

Limitations

When interpreting the results of this study, several limitations must be kept in mind. First, the items assessing apprehension likelihood and severity were not contextualized to either formal nor informal sanctions (e.g., losing a job or family/friend disapproval as a result of the criminal choice) but were generalized. Additionally, potential positive outcomes that could be considered by deliberative decision-making (e.g., the utility of buying stolen goods) were not assessed. Informal sanctions are suggested to be just as influential as formal sanctions in regard to criminal behavior (Anderson et al., 1977; Pickett et al., 2018) and both the perceived psychological and material benefits of committing a crime positively relate to criminal behavior (Baker & Piquero, 2010). It is possible that ego-depletion reduces the influence of formal sanctions, but not informal sanctions and may moderate the influence of positive

[41]For this supplemental analysis I sought to examine which factors are most influential under normal circumstances. Thus, since the depletion group received an experimental manipulation only the control group was suitable for analyses. Furthermore, as this was not a primary purpose of this study, the analysis may be underpowered (N = 193) and results should be taken with caution.

outcomes. Moreover, as approximately 70% of variance in criminal choice was explained in the models presented here, other variables could also be included as predictors, such as morality discussed above. The inclusion of other variables may have redistributed the relative importance of the ones presented here.

Secondly, while superior to other methods such as self-reported criminal behavior, vignette methodologies are not without their flaws. Particularly, regarding the difference between intentions and actual behavior (Exum & Bouffard, 2010). That is, although participants may indicate their intentions, their actual behavior may be incongruent. In an effort to reduce the gap between intention and actual behavior, vignettes that have been used in prior research and that are specific and relatable were chosen (e.g., Fine et al., 2016; Ajzen, 1991; Van Gelder & De Vries, 2014).

Given the fact that most items were assessed using a Likert-scale, the multivariate normality assumption for SEM was violated in both the depletion (χ^2 (12) = 44.736, $p < 0.001$) and control group (χ^2 (12) = 48.415, $p < 0.001$). However, as discussed in Chapter Two, maximum likelihood parameter estimates are relatively robust to reasonable violations of normality, especially when, as in the current study, there is no missing data (McDonald & Ho, 2002; Savalei, 2008).[42] Furthermore, a model with a robust estimator returns very similar results, particularly with perceived risk being significant in the control group but not the depletion group (SRMR = 0.04; Appendix E, Supplementary Figure S14). Moreover, the use of several statistical analyses presented in text demonstrate that risk is not a significant predictor of criminal choice when participants are depleted and speak to the robustness of this finding.[43]

Finally, although the purpose of this chapter and the thesis in general is not to examine a specific crime type, and the norm in the greater literature is to combine several crime types to increase validity, it could be argued that it would make more sense to analyze each scenario separately. That is, as each scenario differs in regard to context and crime type, it may be that

[42]All univariate skewness (0.05 – 1.18) and kurtosis (2.51 – 5.38) statistics were well below the recommended cut-offs of 2 and 7, respectively (Hancock & Mueller, 2013). See Appendix D, Supplementary Table S8 for full individual skewness and kurtosis statistics.

[43]Although not presented in text, an additional linear regression of Criminal Choice on the variables discussed here by groups returned very similar estimates, namely risk was significant in the control group but not the depletion group (Appendix D, Supplementary Table S9; Appendix E, Supplementary Figures S15 – S18).

different predictors would be more influential for certain crimes compared to others, regardless of state differences. For example, affective variables, a key component of intuitive decision-making may be particularly important predictors for reactive or "in-the-moment" crimes involving violence (e.g., Athens, 2005). Conversely, the risks and rewards components that align with traditional RCT perspectives may be more important for proactive or planned crimes, such as white collar crime (e.g., Huisman, 2017). In addition to different types of crime, the scenario more generally may also influence what predictors of criminal choice. For example, as discussed above with habituation, familiarity within an scenario may influence decision-making. In a familiar scenario people may be more driven by habituation, intuition, norms and emotions. Conversely, in unfamiliar scenarios people may be more driven by cognitive factors and weighing the pros and cons of outcomes (e.g., Wikström et al., 2012).

When examining each scenario separately, there is no difference in the mean likelihood of offending between conditions for any of the scenarios. That is, participants in the depletion and control conditions did not differ in regard to criminal choice in any scenario. This aligns with the results presented above at the combined level. However, the SEMs slightly differ between each scenario. The same results presented above in text were returned for negative affect, positive affect, and perceived social consensus in relation to Criminal Choice. For example, in all four scenarios, Negative Affect was negatively related to criminal choice.[44] However, there were differences observed regarding the relationship between perceived risk and criminal choice. Specifically, perceived risk is only significant for the control group in the illegal downloading scenario, in all other scenarios it is non-significant for both conditions. However, the current research is not able to explain the causal mechanism driving this difference. That is, although the vignettes clearly differ in regard to content and the crime at hand, since none of the vignettes were designed to systematically vary in regard to habituation, eliciting emotions, or eliciting risk, I am unable to reasonably or justifiably determine why the differences emerge at the individual scenario level. Nonetheless, I recognize the above limitations and encourage future research to build on the model by estimating informal sanctions, perceived gains, morality, and habituation at a general as well as specific level of crime. This may be achieved by either looking at crime types or scenarios that are hypothesized or designed to elicit certain predictor (e.g., affect).

[44] As this analysis was exploratory, only a simple path analysis was conducted.

Conclusion

The idea of 'what information when' has been considered by prominent researchers in the field of criminal decision-making. For example, Van Gelder and De Vries (2016) argue, "…that these traits are likely to be differential related to the way situational characteristics, such as costs and benefits, are perceived" (p. 702). To address this question, in this chapter, I sought to understand how state self-control influences the relationship between perceived risk, negative state affect, positive state affect, and social consensus in relation to criminal behavior. In doing so, I aimed to contribute to both the criminal decision-making literature as well as the general ego-depletion literature. Although yielding mixed results for other hypotheses, these results do suggest that lower levels of state self-control decrease the influence of cognitive risk factors. In other words, in a moment in which self-control is reduced, the threat or severity of formal sanctions may be less influential than affective or normative deterrents; however, this relationship may be moderated by crime type and habits. Moreover, regardless of state self-control levels, positive and negative affect as well as normative factors predicted criminal choice. These findings further support the notion that not only do intuitive decision-making factors such as emotions and norms predict criminal behavior, when state self-control is low they may be the only predictors.

Chapter Four: The Virtual Reality Method in Criminal Decision-making: Presence, Realism, and Ego-depletion

So far I have demonstrated that in addition to perceived risk, factors such as emotions, heuristics, and overall intuitive decision-making influence criminal decision-making. Moreover, as demonstrated in Chapter Three, such factors may be the only significant predictors when state self-control is low. The following chapters will now focus on the methodology of assessing criminal decision-making. The measurement of criminal behavior has always been an issue for social science research, and while many forms of criminal behavior measures exist, each must be considered in terms of trade-offs in relation to the larger research question. For example, while official statistics such as the Uniform Crime Reports (U.S. Department of Justice, 2004) increase the accuracy of counts, differences in reporting styles between locales, variation in coding of data between years, and lack of individual level psycho-social variables limit its use to understand crime causation and criminal decision-making (Walsh, 2011). Individual interviews with a sample of known offenders retain the accuracy of offense counts and allows for researchers to assess psycho-social variables that may associate with crime, but pose a number of pragmatic issues such as, gaining access to such populations, being costly (Schlosser, 2008), ethical concern regarding true informed consent (Valera et al., 2014), and given the non-experimental setting, the theoretical limitations of assessing causation. Finally, while surveys that match known offenders to an appropriate control group or use a self-reported measure of criminal behavior may increase sample size and reduce costs, they are cross-sectional, only allowing correlations to be drawn, and may suffer from social desirability response biases (Krumpal, 2013).

Vignettes

In response to such limitations, the vignette methodology has become a staple for research examining criminal decision-making (Exum & Bouffard, 2010). Such methodology removes the time delay of retrograde narratives, increases control by exposing participants to the same text, opens up the possibility for experimental manipulation (e.g., changing aspects of the scenario to see how it influences intentions), and allows for the examination of proximal and distal factors in relation to criminal choice.

However, there are still a number of limitations that must be considered. First and perhaps most importantly, it is suggested that a few lines of text cannot appropriately illustrate

the nuances of a real-world scenario (e.g., nonverbal indicators of another person) and may not elicit factors such as emotions and heuristics (Exum & Bouffard, 2010). As demonstrated in this thesis and the greater literature, such factors are associated with criminal decision-making (McClanahan & van der Linden, 2020; Carmichael & Piquero, 2004; Cesar & Decker, 2017; Van Gelder et al., 2019). This empirical support comes from research using in-depth interviews and experimental methods such as written vignettes. Thus, while vignettes may elicit *some* emotion, I argue the inability to provide the nuanced information experienced in day-to-day life limit their ability to elicit emotion to the degree an individual would experience in the real world (Exum & Bouffard, 2010; Van Gelder et al., 2014, 2019).

Secondly, the use of a hypothetical scenario is reliant on participants' abilities to imagine themselves in that scenario, a factor known to vary both between individuals (e.g., Green & Brock, 2000) and as a function of familiarity with the hypothetical scenario (Van Gelder et al., 2019). For example, compared to participants tasked with imagining events in unfamiliar settings (e.g., being on vacation in Polynesia), participants asked to imagine events in familiar settings (e.g., a day at university) provide more details, describe the imagined scenario more vividly, and indicate a greater sense of experiencing the imagined event (de Vito et al., 2012; Szpunar & McDermott, 2008).

Thus, although vignette research has a number of strengths that increase control and the ability for experimental manipulation, the lack of nuanced queues, difficulty in eliciting emotions, and a reliance on a participant's imagination can culminate in poor generalizability from hypothetical responses to real-world criminal behavior. Put simply, it is possible that written hypothetical scenarios are conceptually distant and *distinct* from real-world behavior; thus, participants may indicate that they would or would not display criminal behavior in a hypothetical scenario, but would behave differently in the real-world (i.e., an intention-behavior gap).

While theories vary in regard to their specific predictors (e.g., norms versus attitudes) of how people will behave in different domains (e.g., health related behaviors versus voting behaviors), there is considerable consensus that how one intends to behave is a predictor how they will actually behave (Ajzen, 1991; Fishbein & Ajzen, 1975; Rogers, 1983; Sheeran, 2002; Sheeran & Webb, 2016). Nonetheless, meta-analyses across various domains examining a wide range of behaviors have shown that while the correlation between an intention derived from

laboratory study and actual behavior is moderate (e.g., $r = 0.53$; Sheeran, 2002), it isn't a perfect predictor and only explains an average of 28% of the variance (Sheeran, 2002). Therefore, there is often a discrepancy between what someone says they will do and what they actually do. Because a written hypothetical scenario is: 1) not the real world, 2) unable to provide nuanced information prevalent in the real world, and 3) limited in its ability to elicit factors such as emotions, the behavior a participant indicates they *would* exhibit, may not be the behavior they *actually* exhibit, ultimately limiting the ecological validity of any findings or resulting theory.

This distinction between hypothetical behavior and real-world behavior may also limit the ability to detect differences between known correlates of criminal behavior, namely state variables, such as alcohol consumption and state self-control as discussed in Chapter Three. As noted above, the 'anti-social/criminal' dependent variables used in the ego-depletion literature are often abstract (at worse) and non-criminal (at best). However, by reducing the conceptual distance between a vignette and the real world, we may: 1) retain experimental control, 2) detect theoretically driven effects (i.e., ego-depletion increasing criminal behavior), and 3) be more confident that the findings approximate real-world behavior.

Virtual Reality

While once considered science fiction, recent technological advancements have allowed for not only the development of high powered, realistic Virtual Reality (VR) equipment, but at an affordable cost as well. VR refers to an artificial world (computer generated or otherwise) that can be experienced through the senses (van Gelder, Otte, & Luciano, 2014). Within VR, there are three interrelated concepts that may reduce the conceptual distance between hypothetical scenarios and the real world: immersion, presence, and interactivity.

Immersion refers to the level of sensory perception input from the virtual world relative to the real world (Loomis et al., 1999). For example, in a fully immersive virtual reality users wear a Head-Mounted Display (HMD) in which all visual stimuli come from the virtual world and all audio comes from attached headphones. This minimizes stimuli from the real world. Conversely, a traditional computer game would be considered non-immersive as no effort is made to actively block out the real world. Presence refers to the psychological concept of being

within the virtual world, rather than in real world where the body is located. Unlike a written vignette which relies on a participant's ability to imagine a scenario (an individual difference discussed above; Green & Brock, 2000; de Vito et al., 2012; Szpunar & McDermott, 2008; Van Gelder et al., 2019) VR provides this information by default. This reduces the reliance on the individual to imagine the scenario and may naturally increase the presence for participants (Ticknor, 2018).

Finally, interactivity is a functional factor of VR equipment that may influence the overall immersion and presence felt by a participant (Welch et al., 1996). Broadly, interactivity can be understood to be the amount the participant can influence the virtual environment or content around them (Steuer, 1992). By allowing a participant to move from the role of a passive observer to that of an actor within the virtual environment, their subjective presence may increase (Hu et al., 2005). Interactivity is even considered to be more important than other factors that may influence presence, such as pictorial realism (Welch et al., 1996).

Furthermore, VR can easily provide a wealth of information that a few lines of text cannot provide and has been observed to elicit visceral reactions such as emotions better than traditional written vignettes (Ticknor, 2018). For example, when assessing moral decision-making using traditional hypothetical scenarios such as the trolley dilemma, compared to participants reading a written vignette, participants in a VR condition display an increased heart rate (Francis et al., 2016). Moreover, the use of VR compared to a traditional written vignette increases emotive arousal (as measured by Skin Conductance Response; Patil, Cogoni, Zangrando, Chittaro, & Silani, 2014). Thus, through an increase in immersion, interactivity, and presence, VR may elicit factors such as emotions more than written vignettes.

Interestingly, researchers have observed a divergence of indicated behavior between written vignettes and VR (e.g., Francis et al., 2016; Patil et al., 2014; Van Gelder et al., 2019). That is, participants may differ in their chosen behavior based on how the vignette is presented (i.e., VR versus written). Therefore, it is possible that findings from studies using VR may differ from previous findings established using written vignettes.

The central and novel purpose of this chapter was to compare the presentation of a vignette as traditional written text to presenting the same vignette as a VR module.[45] Specifically, I sought to compare the two methodologies in regard to presence and realism. Additionally, by using improved methodology (i.e., VR versus written text) it is possible to examine factors that are theorized to influence criminal decision-making but may be difficult or unable to be observed using traditional methods. Therefore, as a secondary purpose I sought to re-examine the relationship between state self-control and criminal behavior evaluated in Chapter Three. Finally, as will be seen below, there are several similarities between this chapter and previous work, most notably Van Gelder and colleagues' 2019 study. However, this chapter should not be viewed as a direct replication. Instead, as several elements differ between this chapter and their study (e.g., dependent variables and ego-depletion), this chapter should be viewed as an extension to their work. Finally, while criminological research tends to primarily examine criminal alternatives as outcome measures, less research examines traditional predictors (e.g., perceived risk, negative affect, and individual differences) in relation to non-criminal alternatives. For example, it is well-established that risk is negatively related to criminal behavior, but it is less well-understood if it is positively related to law-abiding behavior. Thus, in this chapter I assess both criminal and law-abiding alternatives. Using a standard vignette scenario presented as either a VR module or a written vignette and a standard ego-depletion in this 2 (VR vs. written) x 2 (Depletion vs. Control) experiment, it was hypothesized that:

> **H1 –** Compared to participants in the written condition, VR participants will report more subjective presence.
>
> **H2 –** Compared to participants in the written condition, VR participants will report more perceived realism.
>
> **H3 –** An interaction will occur between ego-depletion and VR, so that those depleted of their state self-control and are in the VR condition will be more likely to choose an aggressive behavior compared to other conditions.

[45]For clarity, as previous chapters of this thesis only examined one form of vignettes (i.e., traditional written text), the term 'vignette' has strictly referred to a hypothetical scenario presented as text. However, going forward the term 'vignette' is used for the presentation of a hypothetical scenarios in a variety of formats. As such, care has been taken to specify when referring to a VR vignette (i.e., a hypothetical scenario presented in a VR module), a written vignette (i.e., a hypothetical scenario presented in traditional written text), or a video vignette (i.e., a hypothetical scenario presented as a video).

Method

Participants

Using the effect sizes of previous research (d = 0.40; van Gelder et al., 2019), an *a priori* power analysis revealed that with an alpha of 0.05 and a power of 0.90, at least 272 participants in total would be needed to observe a main effect of condition (i.e., VR vs. written) on presence. As the study was a 2 (Depletion vs. Control) x 2 (VR vs. written) design, 68 participants were sought for each potential grouping (e.g., VR - Depletion Group), equating to 136 participants in the written condition and 136 participants in the VR condition.

Covid-19 Interruption and Sample Size

This research project was required to terminate early as a result of the COVID-19 pandemic. Specifically, the project was set to run from October 2019 to May 31st, 2020. However, due to the pandemic and resulting university as well as government policies, data collection ceased from March 13th. With the university still restricting in-person testing (especially testing that requires interaction with subjects), the possibility of collecting more data within a reasonable timeframe for the PhD was not possible. As such, the decision was made between myself and my supervisor, Dr. Sander van der Linden, to terminate VR data collection. This resulted in an underpowered VR study (N_{vr} = 46).[46] Therefore, all statistical analyses presented in this chapter below should be taken with caution.

Due to the nature of the vignette used (described below), to be able to participate, participants were required to be 18 years of age, English speaking, self-identify as a Man, and either be Bi- or Heterosexual.[47] Additionally, although very unlikely, to reduce the possibility of participants becoming disoriented, dizzy, or light-headed within the VR condition, within all advertisements it was indicated that the study was not suitable for participants prone to

[46]As I am still unable to test participants in-person, the remaining funds were subsequently used to expand on this chapter by assessing how a hypothetical scenario presented either as a video or traditional written text differed in regard to presence, realism, and criminal choice (Chapter Five).

[47]It must be noted that researchers did not know the biological sex of the participants, but instead sought participants that self-identify as a man.

motion-sickness.[48] All participants identified as male and were either bi- or heterosexual (Table 9). With the primary source of participants for the VR condition being students, the average age was younger than in previous chapters (M = 28, SD = 9) and 42% of the sample identified as full-time students.

Table 9

*Sample Characteristics (*N *= 244)*

Characteristic	Mean or Modal Response
N	244
Sex	100% Male
Age	*M* = 28 (*SD* = 9)
Ethnicity	Modal Response (81%) - White
Employment Status	Modal Response (42%) – Full-time student
Education	Modal Response (67%) – Undergraduate or Higher
Marriage Status	Modal Response (59%) - Single

Procedure

Participants for the VR condition were recruited using the Department of Psychology Research Sign-up System (SONA; Appendix A, Advertisement 3), departmental and college emails, as well as through flyer distribution throughout the university (Appendix A, Advertisement 4). Participants in the written condition were recruited through the online labor crowdsourcing platform, Prolific Academic (Peer et al., 2017). A standard ad (Appendix A, Advertisement 5) was published on the Prolific Academic platform asking people to participate in a survey about people's attitudes and beliefs. All items, informed consent, and debrief were uploaded to the survey platform, Qualtrics (Qualtrics, 2019).

VR Condition Procedure

On arrival, participants in the VR condition first read over the participant information sheet and provided their informed consent (Appendix B, Consent From 3). In accordance with previous research (e.g., Niforatos et al., 2020), to ensure participants knew how to operate the

[48]All inclusion and exclusion criteria were set using Prolific Academic's internal prescreening selection criteria. When users create an account on Prolific Academic they are required to answer demographic questions, these answers allow researchers to screen for aspects such as sex, gender, country of residence, age, and other specificities such as those used in this study.

VR equipment and were comfortable with the HMD, participants were then given approximately 5 minutes to explore a "virtual home" in a practice module. In this time, I made any adjustments required (e.g., comfort, visual clarity, audio level, controller configuration). Afterwards, participants sat a computer and began the first half of the study in which they participated in a survey which included control items, an ego-depletion task, and manipulation check (discussed below in the Measures and Manipulation Sections, respectively)

Once completing the first half of the study, participants were then equipped with the HMD display for the treatment module (i.e., the criminal vignette described below). The module lasted approximately two minutes and 30 seconds and required participants to make one decision by pointing their controller and selecting their desired choice. Once the participant made their decision, the HMD was removed, and they continued with the second half of the study which included follow up questions regarding the module and a debrief (Appendix B, Debrief 3). Upon completion, participants were thanked, paid £8.00[49] in compensation, and given time to ask questions or share comments regarding their experience. The entire testing procedure on average lasted 38 minutes.[50]

Written Condition Procedure

Participants in the written condition followed a link in the advertisement on Prolific to a landing page in which they read an information sheet and provide their consent (Appendix B, Consent From 4). The remaining procedure for participants in the written condition was mirrored to the VR condition. However, instead of experiencing the scenario in fully immersive VR, participants read a text describing the exact same scenario. Once completing the study, participants were thanked, debriefed (Appendix B, Debrief 4), and paid £1.25 in compensation. On average, the testing procedure for participants in the written condition took 20 minutes.

[49]Thank you to the Boak Fund at Clare Hall for funding this project
[50]To estimate completion time and ensure a smooth procedure for all participants, the procedure was initially piloted tested with colleagues.

Measures

Self-control

As in Chapters Two and Three, for consistency, the 8-item, two-dimension version (Maloney et al., 2012) of the Brief Self-control scale (Tangney et al., 2004) was used to measure trait self-control (α = 0.80, *M* = 23.40, *SD* = 5.83; Appendix C, Set 1). All items were on a 1 (Not at all like me) to 5 (Very much like me scale).

Trait Aggressiveness

To control for trait aggressiveness, the 12-item Buss and Perry Aggression Questionnaire Short form (originally developed by Buss and Perry (1992) and later adapted to a short form by Bryant and Smith (2001) was used (α = 0.84, *M* = 28.57, *SD* = 8.26; Appendix C, Set 10). Both the original and short form have displayed consistent construct validity (Tremblay & Ewart, 2005) and the short form has displayed factor invariance (across genders) as well as concurrent validity in a group of federal offenders (Diamond & Magaletta, 2006). The scale consists of four subdimensions: 1) Physical aggression 2) Verbal Aggression 3) Anger, and 4) Hostility. Anger may be considered emotional component of an aggressive behavior; conversely, hostility is more cognitive (Buss & Perry, 1992). Example items include: "Given enough provocation, I may hit another person (Physical)", "I often find myself disagreeing with people (Verbal)", "I have trouble controlling my temper (Anger)", and "At times I feel I have gotten a raw deal out life (Hostility)". All items were on a 1 (Extremely uncharacteristic of me) to 5 (Extremely characteristic of me) scale.

Decision-making Styles

As in Chapters Two and Three, the 10-item, Decision-making Styles Scale (Hamilton et al., 2016) was used to control for trait differences in decision-making styles. The scale consists of two dimensions, deliberative (α = 0.85, *M* = 20.30, *SD* = 3.42) and intuitive decision-making (α = 0.75, *M* = 13.85, *SD* = 3.42). All items were on a 1 (Not at all like me) to 5 (Very much like me) scale (Appendix C, Set 2).

PANAS Short Form

To minimize the possibility that any differences in outcome variables between depletion and non-depletion groups was due to the possibility of frustration or anger as a result of the depletion task, I controlled for state affect using the International Positive and Negative Affect Short Form (I-PANAS-SF; Thompson, 2007; Appendix C, Set 12). The I-PANAS-SF (derived from the original PANAS; Watson, Clark, & Tellegen, 1988) has exhibited an international level of cross-sample stability, reliability, factor invariance, and convergent as well as criterion validity (Thompson, 2007). The items were primed with the phrase, "On a scale from 1 (Very slightly or not at all) to 5 (Extremely) please indicate to what extent the following words describe how you feel this way, right now, at the present moment." Participants then ranked both positive ($\alpha = 0.78$, $M = 16.52$, $SD = 3.94$) and negative emotions ($\alpha = 0.83$, $M = 9.11$, $SD = 4.20$) such as, "Inspired", "Alert", "Nervous", and "Hostile".

Criminal Choice

Several considerations were taken into account when creating the outcome variable for this chapter. In their original article, Van Gelder and Colleagues (2019) had participants experience a scenario in VR and then state what they would do in that situation in a survey afterwards. The authors note that this time delay may have inadvertently acted as a cooling-off period that may have directly or indirectly influenced their indicated behavior. For example, in the moment a participant may have had a high likelihood of behaving aggressively or criminally. However, with the time delay between experiencing the scenario, taking off the VR equipment, and resuming the survey, they could have reflected on their initial reaction and decided that it was not the best thing to do and changed their mind. Similarly, a participant may have felt angry in the moment when experiencing the scenario in VR, but by the time they answered the questions this anger may have dissipated and therefore their behavior differed. Collectively, this time delay could have resulted in participants indicating that they would have exhibited a different behavior than what a they would have done in the moment (e.g., Fishbein & Ajzen, 1975). Additionally, as discussed in the literature review above, interactivity can increase the subjective presence felt by participants (e.g., Welch et al., 1996). Therefore, in this study I created an interactive element within the VR module by placing a discrete choice outcome variable within the module itself (further discussed below in Scenario and

Equipment).[51] In doing so, I hoped to reduce the possibility of creating a cooling-off period that may introduce bias into the outcome measure and increase subjective presence.

Additionally, rather than focusing solely on criminal behavior, I also chose to include non-criminal behavior. The overwhelming majority of criminological literature has primarily examined criminal behavior as the only outcome variable of interest. However, law-abiding and non-violent behavior is an important aspect that should be modeled as well. That is, it would be interesting and important to know if the same predictors that predicted criminal behavior, predicted law-abiding behavior to a similar degree (albeit in the different direction). Therefore, rather than asking participants if they would or would not commit a crime (i.e., yes or no), I included a non-criminal alternative in the set of options in the discrete question.

Finally, when assessing criminal decision-making, outcome variables are often skewed towards zero (as discussed in the results section of: Exum et al., 2012). This skew may reduce data granularity, violate most assumptions, and overall make statistical analyses complicated. This skew may also increase when using discrete outcome variables as discussed here. As such, I included additional Likert-scale items that were answered after answering the question with discrete options.

For the discrete options, participants in the VR condition were displayed the phrase, "What would you do" for five seconds, then three alternatives including, "Just walk away", "Shove the guy", and "Hit the guy with a bottle" were displayed (Modal response (63%) = Just walk away). Participants were then free to choose which alternative they wanted by using the handheld controller. Participants in the written condition were given the same priming phrase and alternatives as participants in the VR condition, but this information was displayed as written text following the written scenario (Appendix C, Set 13).

As a second measure of criminal choice, Likert items were also included to increase the granularity of the data. Three Likert items were displayed to all participants after making their discrete option. The Likert items were primed with the phrase, "In a similar scenario to the one you just experienced, how likely it is that you would…" and all participants were given the

[51] While it is possible that Likert-scale items could be placed within a virtual environment, doing so was outside the capabilities of my personal coding skills.

same three options provided in the discrete question on a 1 (Not at all likely) to 7 (Extremely likely) scale (M_{walk} = 5.11, SD_{walk} = 1.86; M_{shove} = 3.74, SD_{shove} = 1.91; M_{hit} = 1.58, SD_{hit} = 1.17; Appendix C, Set 14).[52]

Presence

In congruence with previous research (Van Gelder et al., 2019), presence was measured using the adapted version of the Igroup Presence Questionnaire (α = 0.88, *M* = 31.89, *SD* = 8.33; Schubert, Friedmann, & Regenbrecht, 2001; Appendix C, Set 15). All items were primed with the phrase, "Think back to when you were imagining the scenario [or in the VR condition: Think back to when you were in the VR experience] and please indicate on a 1 (Strongly disagree) to 5 (Strongly agree) scale how much you agree with the following statements". The items were adapted to fit the context of both VR and a written scenario. For example, the item "I was fully aware of the real world around me in the VR experience" was amended to "…when imaging the scenario" in the written condition. Other example items include, "I was completely captivated by the scenario" and "I had a sense of acting within the scenario".

Realism

To measure the perceived realism of the scenario, six items were used from previous research (α = 0.82, *M* = 29.73, *SD* = 6.65; van Gelder et al., 2019; Appendix C; Set 16).[54] As the original items were in written in Dutch, they were independently translated by two native-speaking colleagues, with all items being translated to the same English phrase. All items were primed with the phrase, "Considering the situation you just read and imagined [or in the VR condition: Considering the VR experience you just had], please indicate on a 1 (Strongly disagree) to 7 (Strongly agree) scale how much you agree with the following statements". Example items include, "The scenario was clear" and "I thought the scenario was fictitious (reverse coded)".

[52]To reduce potential ordering biases, Likert outcome variables were presented in a random order to all participants. However, due to coding limitations within the VR module, discrete options were always presented in the same order ("Just walk away", "Shove the guy", "Hit the guy with a bottle").

Risk and Affect

As in Chapter Three, as indicators of both rational and intuitive decision making, I assessed both the perceived risk and state affect experienced during the module. Following previous research (e.g., Nagin & Paternoster, 1993; Van Gelder & De Vries, 2012; van Gelder & de Vries, 2014), perceived risk was measured as a composite of both the likelihood of negative consequences and severity of said consequences for exhibiting an aggressive behavior (M = 74.26, SD = 21.66; van Gelder & de Vries, 2014; van Gelder et al., 2019; see Chapter Three for detail on item composite creation). Four perceived risk items (Appendix C, Set 17) were primed with the phrase, "Think back to the moment you made your decision and indicate on a 1 (Disagree entirely) to 5 (Agree entirely) scale, how much you agree with the following statements" with items such as, "The likelihood of negative consequences for an aggressive decision was very high" and "An aggressive decision would not have any serious consequences (reverse coded)".

In accordance with previous research (e.g., van Gelder et al., 2019), affective states measured included anger (α = 0.90, M = 21.11, SD = 7.49), as well as negative (α = 0.86, M = 18.15, SD = 7.08; e.g., van Gelder & de Vries, 2014) and positive state affect (α = 0.70, M = 11.75, SD = 4.78; Appendix C, Set 18). 15 items in total (five each for anger, positive, and negative) were primed with the phrase, "Did the situation that you just experienced [or, in the written condition: Did the situation you just read] make you feel…" and were scored on a 1 (Not at all) to 7 (Very much) scale. Example items include, "…Insecure", "…Thrilled", and "…Irritated".

Scenario and Equipment

Scenario

The chosen scenario is an adapted "bar fight" scene that has been used in traditional written vignette research (e.g., Exum, 2002) as well as VR research (van Gelder et al., 2019). Participants take the perspective of a protagonist on a date with their girlfriend, Lisa. After returning from paying the bill another man is "hitting on" Lisa, a verbal altercation then ensues, and participants must indicate what they would do next.

Written Vignette

In the written group, participants are told to imagine the scenario and were presented text describing the situation as well as a transcript describing the verbal altercation with the other man (Appendix C, Set 13). Participants then indicated what they would do both as a discrete and continuous option.

VR Equipment

In the VR condition, participants were presented the same scenario as a 360° video using an HTC Vive VR system (Figure 5). The HTC Vive VR System is a fully immersive virtual reality experience equipped with 360° headset and controller tracking, directional audio, and high-definition visual output. The HTC Vive VR System is powered by the digital distribution software, Steam VR. The HMD displays visual stimuli on a 3.6", 2160x1200 pixel screen with adjustable lens distance for individual user comfort. As clear audio separate from the real world is essential for an immersive experience, in this study the Vive Deluxe Audio Strap was used for increased audio quality. The handheld controllers included a multifunction trackpad as well as system, grip, and menu buttons. However, for the purpose of this study, the only function used on the controller was the dual-stage trigger which allowed participants to choose an option when displayed a set of alternatives. [53]

[53]The study space used was approximately 3m x 4m, well within the minimum range required of the VR kit of 2m x 1.5m. The base station sensors were mounted appropriately at opposite corners of the "play area", approximately 2m from the floor, titled at a 45° angle, facing one another. To minimize the possibility of dizziness or injury, participants were sat in a chair.

Figure 5

HTC Vive Immersive Virtual Reality Headset and Controls

The video is filmed in first-person with participants taking the perspective of the man on a date with their girlfriend, Lisa. Participants were also provided with the same introductory narration text and experience the same verbal altercation provided to participants in the written condition.[54] The participant may freely look around for the duration of the entire module. In previous research, participants would experience the module in VR and then indicate what they would do in a survey afterwards (see Van Gelder et al., 2019). However, as discussed in the literature review, interactivity may increase presence and thus increase the likelihood that decision-making in VR will generalize to real-world behavior. Therefore, I modified the original VR module to a branching narrative in which participants could indicate what they would do within the VR module itself by use of the handheld controller (i.e., pointing and selecting their behavior from the discrete options described in the Measures section above) and observe that behavior occur.

Branching Narratives. Traditional video games, movies, and VR modules are considered to be a linear narrative, in which a user may have some control within the game, but the outcome of each scenario is either success (in which the next, prescribed scenario begins) or failure (in which the current scenario is replayed until it is successful; Riedl &

[54]I thank Dr. Van Gelder for providing the realism items as well as the VR video stimulus for this project. For details on how the video was created please see (Van Gelder et al., 2019).

Young, 2006). In such a scenario, every individual will experience the same storyline. Conversely, branching narratives allow for more user input that allows for unique experiences. Particularly, at the conclusion of one scenario the video game, module, or movie may allow the user to make a choice on what to do. The user is then put on a narrative track to experience the selected option, meaning users will only experience the narrative chosen and not the other potential narratives, creating a unique experience between users. To increase interactivity and presence of the VR condition, rather than participants observing a film in a VR headset, I created a branching narrative using a variety of video editing software.[55]

To create the branching narrative, two identical videos with different endings were used. In one video, in the final scene the protagonist hits the antagonist on the head with a wine bottle (hereby referred to as the "Hit" scenario). In the other video, in the final scene the protagonist shoves the antagonist in the chest (hereby referred to as the "Shove" scenario). First, both videos were individually centered and cropped using the program HandBrake to fit within the viewing field of the VR headset. Secondly, using Window's Video Editor, the Hit video was edited to end at the moment of climax between the protagonist and antagonist (hereby known as "baseline video"). This edited video was used as the introductory video for the VR module. The Hit video introduction was chosen because the introduction sound quality was the clearest of the two videos. Using Window's Video Editor, both the Hit and Shove videos were then edited and cut to only include their respective endings. Finally, a still frame photo was taken at the moment of climax between the protagonist and antagonist to serve as the selection fame (hereby referred to as "selection pane", Figure 6). The editing process resulted in three videos: 1) a baseline with the narrative introduction, 2) the ending of the Hit video, and 3) the ending of the Shove video as well as one still frame photo (Figure 6).

[55]While many advance programs exist that would make this a simple task, they were out of the budget of this doctoral thesis and are not necessarily compatible with the HTC Vive Kit used within this study.

Figure 6

Selection Pane

Notes. The figure was presented to participants within the HTC Vive Headset for approximately 5 seconds before being shown the potential alternatives to choose from.

Window's Paint was used to create a concluding image for the immersive VR experience that is played at the end of the video, regardless of which option was chosen, and instructs participants that the portion of the study is over and they make take off their headset (hereby known as "concluding image", Appendix E, Supplementary Figure S19). To ensure the image would be displayed appropriately within the VR headset as a 360°, both the selection page and concluding image were converted from 180° to 360° using the free conversion website, phtooxy.com.

To allow for editing, all videos were first converted from 360° to 180° using the program VSDC Free Video Editor. Three layers of white text with a black background were then added to the selection pane (hereby referred to as "discrete outcome", Figure 7). Each layer of text on the selection pane was one of three options, "Just walk away", "Shove the guy", or "Hit the guy with a bottle". The discrete outcome pane and concluding image were then

edited to extend its duration to 30 seconds.[56] The selection and discrete outcome panes were then stitched to the end of the baseline video. The concluding image was then stitched to the end of both the ending videos for each scenario. All files were finally exported as an MP4 at 2880x1440 pixels.

Figure 7

Discrete Outcome Pane

Notes. The discrete outcome pane was shown to participants within the HTC Vive headset. Participants then could select which behavior to display by clicking a corresponding arrow underneath each.

Finally, all videos and images were uploaded to the branching narrative software, Wonda VR Spaces. Wonda VR Spaces was chosen as it is free software that allows VR content to be viewed either in desktop or VR headset mode. Within the Wonda VR Spaces workstation, an action point was added beneath each possible choice on the discrete outcome pane. These action points were programmed so that when selected, the corresponding video would be played. For example, if the action point below the text "Hit the guy with a bottle" was selected, the Hit scenario ending would be played, followed by the concluding image. There was no video available that displayed the protagonist walking away. If this action point was selected participants were immediately displayed the concluding image. To allow for the video to be

[56]It was estimated 30 seconds would provide participants enough time to read all alternatives and select the one they wanted.

viewed in the VR headset, rather than desktop mode, the web browser, FireFox was used. FireFox was chosen as it is a compatible engine for the HTC Vive VR Kit and Steam software.

Manipulation and Manipulation Checks

Ego-depletion task

To increase power and maximize the possibility of detecting an interaction between VR and ego-depletion, the Stroop task (Stroop, 1935) was used to deplete participants of their state self-control. For the Stroop task, participants were randomly divided into two groups (Depletion vs. Control). All participants were told that they would be presented a word and were asked to indicate as quickly as possible what color the word appears in, not what the word says (i.e., the "ink" the word is written in, rather than the actual word itself). Participants in the Depletion condition were given 100% incongruent trails (i.e., the text never matched the color ink) while participants in the Control condition were given 100% congruent trails (i.e., the text always matched the color ink). In accordance with previous research (e.g., Wallace & Baumeister, 2002) participants in the Depletion condition were given an additional instruction indicating that they were to indicate the color of the word, unless that color is red, if it is red, they were to indicate what the word says. For example, [BLUE], in this case the correct answer would be green. However, if the word was presented as [BLUE], since it is presented in red ink, they must override the general rule, and indicate the actual written word, which in this case would be blue.

Using the Qualtrics "Loop and Merge" feature (Qualtrics, 2019) participants were exposed to 144 trials, lasting approximately four minutes.[57] The text was presented on a white background in size 24 font. Each trial was given a three second timer, in which participants had to indicate the correct answer by pressing the corresponding letter for each color (R = Red; G = Green; B = Blue; Y = Yellow). After three seconds passed, the survey would automatically progress to the next trial.

[57]While variations in specifics such as the duration of the depletion task as well as the ratio of incongruent to congruent trails between control and depletion groups exist (e.g., Dahm et al., 2011; Herron, 2019; Radel, Gruet, & Barzykowski, 2019), such factors are suggested to only have a small effect on the outcome variable and accounts for relatively little variance (Hagger et al., 2010).

Recognizing the potential limitations of switching depletion tasks between studies, a meta-analysis comparing a variety of depletion tasks determined that the Stroop task, on average, had a greater effect size than the previously used essay task (Dang, 2018b). Moreover, a pilot-test was conducted to determine which ego-depletion task would have the greatest effect compared to a control group. Compared to participants in the control group, participants that went through the Stroop task were more likely to shove the guy (M_{stroop} = 4.42 vs. $M_{control}$ = 3.27, M_{diff} = 1.15, *SE* = 0.42, 95%CI [0.16, 2.15]; *Tukey* T = 2.75 *p* = 0.019), while participants in the essay task were not (M_{Essay} = 3.97, M_{diff} = 0.71, *SE* = 0.42, 95%CI [-0.30, 1.71]; *Tukey* T = 1.67 *p* = 0.221; Appendix E, Supplementary Figure S20).[58] Additionally, switching ego-depletion tasks between experiments to increase power in the context of aggressive behavior has occurred in previous research (e.g., Staller, Christiansen, Zaiser, Körner, & Cole, 2018). Finally, it is important to remember that although I switched tasks between chapters, I did not switch methodologies in regard to ego-depletion. That is, both the Stroop task and the essay writing task are sequential tasks that are theorized to lead to ego-depletion (albeit to a different degree as discussed above). Thus, I felt comfortable moving forward using the Stroop task instead of the previous essay task.

Manipulation Checks

Consistent with Chapter Three, two follow-up questions assessing difficulty and cognitive demand on a 1 (Not at all) to 5 (Very much) scale were amended from Chapter Three as a manipulation check (*r* = 0.66, *p* < 0.001; *M* = 5.72; *SD* = 2.35; Appendix C, Set 5).[59] Additionally, A state self-control measure was used to assess the effects of the ego-depletion task (α = 0.78, *M* = 24.93, *SD* = 5.56; Appendix C, Set 11). The Brief State Self-control Capacity Scale (Lindner et al., 2019) is a 5-item, abbreviated version of the 25-item State Self-control Capacity Scale (Bertrams et al., 2011). The items are on a 1 (Not true at all) to 7 (Very true) with items such as, "I feel drained" and "I feel like my will power is gone". Higher scores indicate greater state self-control.

[58]Please see Appendix F, Supplementary Text S4 for a detailed description of the Pilot-test and analyses ran.
[59]While participants could have simply let the Stroop task progress with no interaction, analyses suggest this was not the case. Specifically, while the design of the Stroop task did not allow the (in)correct number of responses to derived, as an attention/effort check, of the 144 trials, the number of unanswered trails ranged from 0 (31% of the sample) to 38 (< 1% of the sample). That is, no participant failed to answer all trails and the most trials unanswered was 38. 79% of the sample failed to answer only 5 or fewer trials. This suggests that participants were reasonably engaged with the task.

Results

To ensure groups were not significantly unbalanced on potential confounders, they were first compared using the control variables, trait self-control, trait aggressiveness, and trait decision-making styles.[60] Participants in the written condition indicated greater trait aggressiveness compared to the VR condition ($M_{written}$ = 29.12 vs. M_{vr} = 26.22; M_{diff} = 2.90, 95% CI [0.63, 5.17], p = 0.01, d = 0.35, 95% CI [0.03, 0.68]; Table 10). As such, trait-aggressiveness is controlled for in subsequent analyses. All other comparisons revealed that participants in the VR and Written condition were not significantly different from one another in regard to trait self-control, intuitive decision-making, nor deliberative decision-making.

Table 10

Group Comparison of Confounders

Construct	VR N = 46	Written N = 198	Significance
	M (SD)	M (SD)	
Trait Self-control	23.27 (4.89)	23.41 (6.04)	$t(242) = -0.04$, $p = 0.97$
Intuitive Decision-making	13.48 (2.60)	13.93 (3.58)	$t(91.35) = -0.99$, $p = 0.32$
Deliberative Decision-making	21.04 (2.91)	20.13 (3.52)	$Z = 1.32$, $p = 0.19$
Trait Aggressiveness	26.22 (6.55)	29.12 (8.53)	$t(86.15) = 2.54$, $p = 0.01$

Notes: As trait aggressiveness and intuitive decision-making violated the homogeneity of variance assumption, a Welch's t-test was used (Appendix D, Supplementary Table S13). As deliberative decision-making was non-normally distributed a Mann-Whitney test was conducted (Appendix D, Supplementary Table S13).

To assess if the depletion task was successfully, I examined both the traditional manipulation checks as well as the novel state self-control measure. As can be seen using the traditional manipulation checks, indicating successful depletion, participants in the depletion condition indicated the Stroop task to be more difficult than participants in the control condition (Z = 9.67, p < 0.001; d = 1.57, 95%CI [1.28, 1.85]; Table 11, Figure 8).[61] Moreover, using the novel state self-control scale (Lindner et al., 2019), participants in the depletion condition descriptively indicate less state self-control compared to the control condition. Taking these two findings into account it is reasonable to conclude that participants were successfully depleted.

[60]Please see Appendix D, Supplementary Table S13 for assumption checking for group comparisons.

[61]As the manipulation check was not normally distributed a Mann-Whitney test was used. However, a simple t-test returned similar results for the manipulation check ($M_{depletion}$ = 7.16 vs. $M_{control}$ = 4.27, M_{diff} = 2.89, 95%CI [2.43, 3.36], p < 0.001).

Table 11

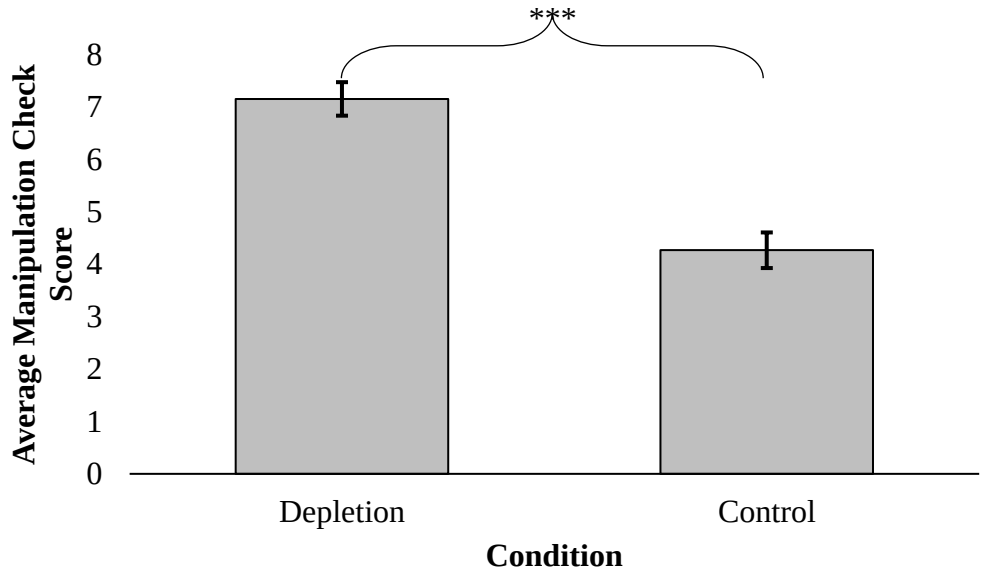
Group Comparison of Manipulation Checks and Confounders

Construct	Control *N* = 122	Depletion *N* = 122	Significance
	M (*SD*)	*M* (*SD*)	
State self-control	25.58 (5.39)	24.38 (5.69)	$Z = 1.64$, $p = 0.10$
Manipulation Check Index	4.27 (1.91)	7.16 (1.78)	$Z = 9.67$, $p < 0.001$
PANAS – Positive	16.07 (4.17)	16.97 (3.65)	$t(242) = -1.80$, $p = 0.07$
PANAS – Negative	8.67 (4.27)	9.54 (4.10)	$Z = 2.16$, $p = 0.03$

Notes. As the negative subscale of the PANAS, state self-control, and the manipulation check index were non-normally distributed, a Mann-Whitney test was used for their comparison (Appendix D, Supplementary Table S14)

Figure 8

Manipulation Check by Condition



Note. Higher scores indicate a greater ego-depletion effect as measured by the two manipulation check questions (Appendix C, Set 5). Error bars represent exact 95% CIs. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

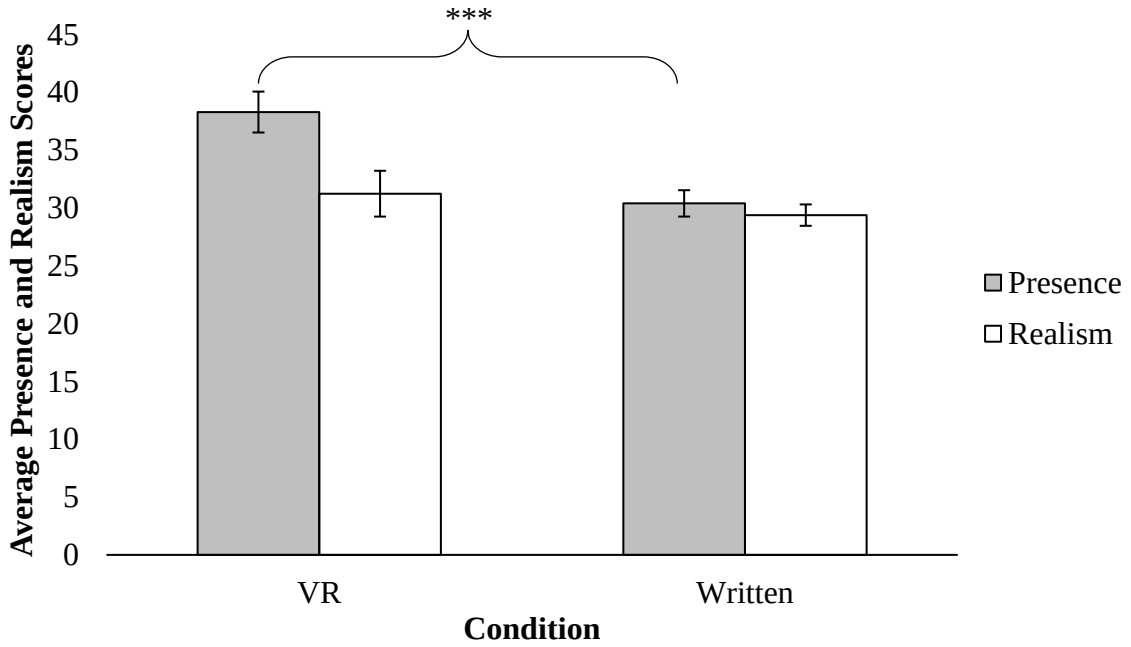
Presence and Realism by Condition

To test the hypotheses that participants in the VR condition would indicate more presence (Hypothesis 1) and realism (Hypothesis 2) simple group comparisons were conducted. First, two simple t-test were conducted. Compared to participants that read a written vignette, participants in the VR condition indicated significantly more presence ($M_{vr} = 38.30$ vs. $M_{written} = 30.40$; $M_{diff} = 7.91$, 95% CI [5.41, 10.40], $p < 0.001$, $d = 1.02$, 95% CI [0.69, 1.35];

Figure 9; Table 12). Participants in the VR condition also indicated they perceived the scenario as more real than participants that read the vignette (M_{vr} = 31.24 vs. $M_{written}$ = 29.38; M_{diff} = 1.86, 95% CI [-0.27, 4.00] p = 0.043; d = 0.28, 95%CI [-0.04, 0.60]; Figure 9; Table 12).

Figure 9

Presence and Realism by Condition



Note. Error bars represent exact 95% CIs. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$. Statistical comparisons are between groups.

Table 12

Group Comparison on Presence and Realism

Construct	VR *N* = 46 *M* (*SD*)	Written *N* = 198 *M* (*SD*)	Statistical Test	Significance
Presence	38.30 (5.94)	30.40 (8.11)	T-test	$t(242) = 6.23$, $p < 0.001$
Realism	31.24 (6.68)	29.38 (6.61)		$t(242) = 1.72$, $p = 0.043$
Presence	-	-	Welch's t-test	$t(90.32) = 7.54$, $p < 0.001$
Realism	-	-	Mann-Whitney	$Z = 1.99$, $p = 0.05$

Notes: As presence violated the homogeneity of variance assumption, a Welch's t-test was used (Appendix D, Supplementary Table S15). As realism was non-normally distributed, a Mann-Whitney test was conducted (Appendix D, Supplementary Table S15).

However, the assumption checks for a t-test revealed that presence violated the homogeneity of variance requirement and realism was non-normally distributed (Appendix D, Supplementary Table S15). As such, a Welch's t-test and Mann-Whitney test were also chosen to analyze between-group differences for presence and realism, respectively. Participants in the VR condition indicated significantly more presence compared to participants in the control condition (M_{vr} = 38.30 vs. $M_{written}$ = 30.40; M_{diff} = 7.91, 95% CI [5.82, 9.99], p = 0.01, d = 1.02, 95% CI [0.69, 1.35]; Figure 9; Table 12). Using a Mann-Whitney test, participants in the VR condition also indicated marginally more realism than participants in the written condition (M_{vr} = 31.24 vs. $M_{written}$ = 29.38; p = 0.05; d = 0.28, 95%CI [-0.04, 0.60]; Table 12).

As participants in the written vignette condition indicated a greater amount of trait aggressiveness, a one-way ANCOVA was used to assess if the group differences remained once controlling for trait aggressiveness. Supporting the simple t-test and Welch's t-test of unequal variances, the one-way ANCOVA for subjective presence was significant (F(2,241) = 24.38, p < 0.001). Both the condition a participant was in (F(1,241) = 44.56, p < 0.001, d = 0.84) and trait aggressiveness (F(1, 241) = 8.68, p = 0.004, d = 0.35) were significant. Specifically, participants in the VR condition indicated a greater subjective presence than participants in the written condition (M_{diff} = 8.42, t(241) = 6.68, p_{tukey} < 0.001, d = 1.10, 95% CI [0.76, 1.44]). Conversely, the one-way ANCOVA for realism was not significant (F(2, 241) = 1.49, p = 0.227). Neither the condition a participant was in (F(1, 241) = 2.99, p = 0.09, d = 0.22) nor trait aggressiveness (F(1, 241) = 0.05, p = 0.82, d = 0.00) were significant.[62]

Taken collectively, the results indicate that participants in the VR condition indicated feeling significantly more present within the hypothetical scenario compared to participants in the written condition but did not necessarily indicate that they found the scenario to be more real. Specifically, while participants indicate a significant difference regarding realism, the confidence interval of both the mean difference and effect size contained zero (as both a simple t-test and Mann-Whitney test). Moreover, when using a ANCOVA to control for trait aggression, there is no significant difference in realism between conditions. Conversely, participants in the VR condition consistently indicated a greater subjective presence than participants in the written condition as a simple t-test, Welch's t-test, ANOVA, and ANCOVA controlling for trait aggressiveness. Furthermore, the effect size was consistently large in

[62]For transparency and comparison, a simple one-way ANOVA without trait aggressiveness as a covariate returned very similar estimates and can be found in Appendix D; Supplementary Table S16.

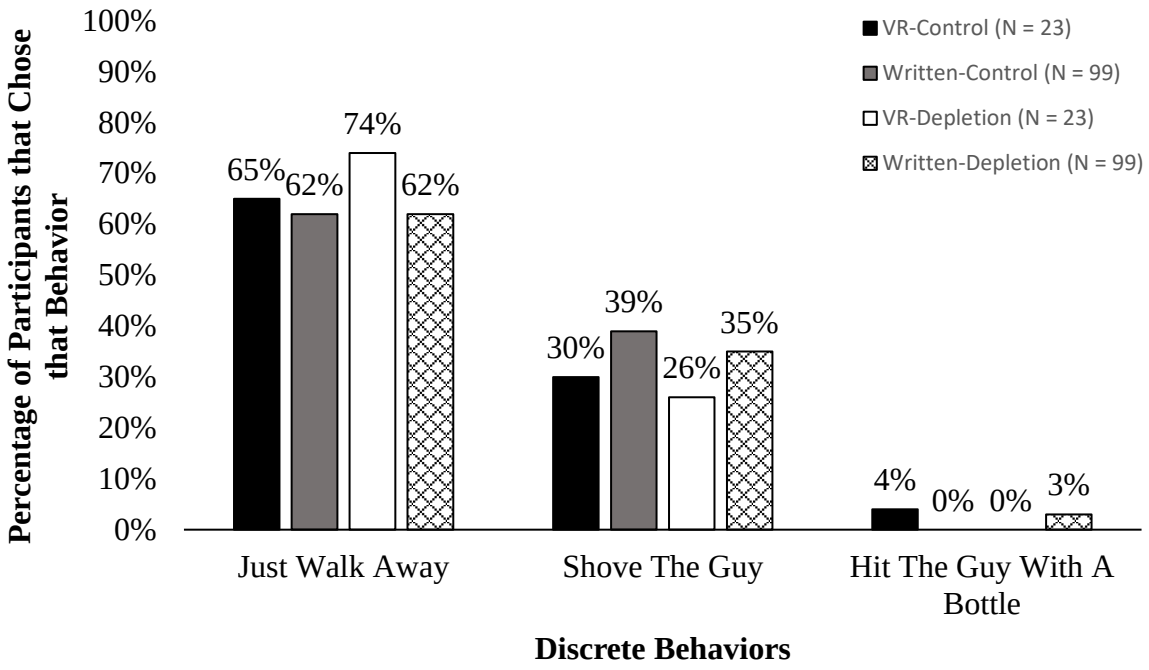
magnitude (ranging from 0.84 to 1.02). Therefore, compared to participants in the written condition, the results indicate that participants in the VR condition experience a greater subjective presence, but do not find the scenario to be more realistic. As such, null Hypothesis 1 may be rejected while null Hypothesis 2 is retained.

Criminal Choice by Condition

Next, I sought to examine if participants that were depleted of their self-control and in the VR condition would be more likely to choose an aggressive behavior than the other conditions (Hypothesis 3). First, I created a simple plot of the discrete and the Likert outcome variables by condition. As can be seen in Figure 10, in all conditions, approximately 63% of participants chose to just walk away. In all conditions, approximately 35% of participants chose to shove the guy. Conversely, only in the VR-Control and Written-Depletion conditions did any participants choose to hit the guy with a bottle (4% and 3%, respectively). Although violating the required cell-size assumption due to a small sample size, a χ^2 indicated no significant difference in criminal choice as a discrete outcome variable by condition (Appendix D, Supplementary Table S17).

Figure 10

Percentage of Participants who Chose to either Walk Away, Shove the Guy, or Hit The Guy With a Bottle, by Condition



Notes. χ^2 (6) = 5.68, p = 0.459.

As the data violates the required cell size distribution for a χ^2, a binary logistic regression was used to further analyze the discrete outcome variable. The choices of "Shove the Guy" and "Hit the Guy with a Bottle" were combined to create a binary outcome variable (1 = Shove or Hit the Guy; 0 = Just walk Away). The condition a participant was in was not significant. Specifically, in reference to the VR-Control group, participants were no more or less likely to choose shoving the guy or hitting him with a bottle if they were in the VR-Depletion condition (Odds Ratio [OR] = 0.66, 95% CI [0.19, 2.35], p = 0.523), in the Written-Control condition (OR = 1.17, 95% CI [0.45, 3.02], p = 0.748), nor in the Written-Depletion condition (OR = 1.17, 95% CI [0.45, 3.02], p = 0.748).[63]

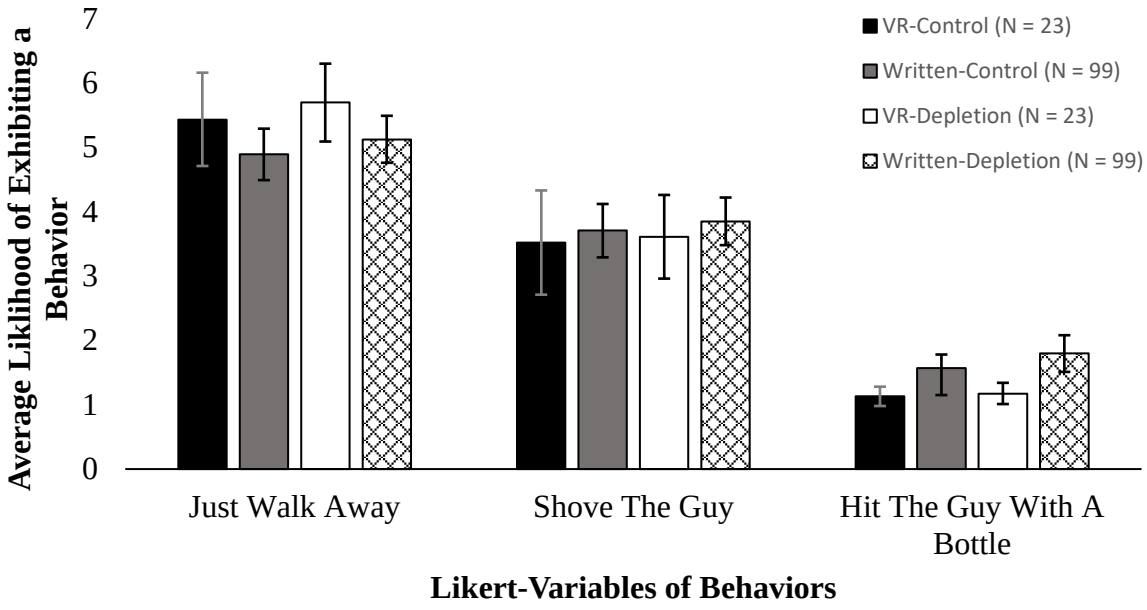
Next, I compared the Likert outcome variables across conditions. As can be seen in Figure 11, when assessing the Likert outcome variables, visually the likelihood of engaging in any of the behaviors on 1 (Not at all) to 7 (Extremely Likely) scale is similar across conditions.

[63]The same analysis using a dummy coded (1 = VR-Depletion, 0 = All other conditions) predictor variable also returned non-significant values (OR = 0.57, 95% CI [0.22, 1.52], p = 0.264).

Specifically, the likelihood of Just Walking Away is highest (*M* = 5.11, *SD* = 1.86), followed by Shoving the guy (*M* = 3.74, *SD* = 1.91) and Hitting the Guy with a Bottle (*M* = 1.58, *SD* = 1.17).[64] Visually, there appears to be no difference across conditions in regard to the likelihood of engaging in any of the behaviors. This aligns with the findings assessing the discrete outcome variable above.

Figure 11

Distribution of the Likelihood of Walking Away, Shoving the Guy, and Hitting the Guy with a Bottle, by Condition



To determine if participants in the VR-Depletion condition were significantly more likely to choose an aggressive response (i.e., "Shove the Guy" or "Hit the Guy With a Bottle") a 2 (VR vs. Written) x 2 (Depletion vs. Control) Multivariate Analysis of Variance (MANOVA) was used. Specifically, the predictor variables were the condition a participant was in while the outcome variables were the three Likert items of 'just walk away', 'shove the guy', and 'hit the guy with a bottle'. As participants significantly differed regarding trait aggressiveness, it was entered to the model as a covariate. Additionally, as with previous research (e.g., Englert et al., 2019; Fischer et al., 2012; Schmeichel et al., 2003), to ensure that any potential observed differences in criminal choice were indeed the result of depletion and not simply the ego-depletion task putting participants in a negative or positive mood, and

[64]The presented averages in-text are for the entire sample (*N* = 244).

considering the negative subscale of the PANAS measure significantly different between the depletion and control conditions (Table 11; $Z = 2.16$, $p = 0.03$, $d = 0.21$, 95% CI [0.04, 0.46], the PANAS scale was also entered as a covariate. While the overall model was significant $F(18,665.20) = 4.38$, $p < 0.001$, this was driven by trait aggressiveness, $F(3, 235) = 14.83$, $p < 0.001$, as neither how the vignette was presented (VR vs. Written), if the participant was depleted, the interaction between the two, nor the negative or positive subscale of the PANAS were significant ($p = 0.16$, $p = 0.49$, $p = 0.86$, $p = 0.75$, $p = 0.23$, respectively).[65] Therefore, participants in the VR-Depletion group were no more likely to choose an aggressive behavior than other conditions, as such, null Hypothesis 3 is retained.[66]

Exploratory Analyses

The small sample size limits the ability to draw meaningful conclusions for the hypotheses above. Previous effect sizes derived from research examining a main effect of presenting a vignette either in VR or as written text include: 1) presence ($d = 0.40$), 2) realism ($d = 0.28$), and 3) criminal intention ($d = 0.18$; Van Gelder et al., 2019). Using an alpha level of 0.05 and the sample size of 244 ($N_{vr} = 46$, $N_{written} = 198$), a post-hoc sensitivity analysis for presence, realism, and criminal intention revealed analyses were operating at 79%, 52%, and 30% power, respectively. As such, caution should be taken when interpreting the above results. However, there are a number of exploratory analyses regarding the other predictor variables in relation to criminal and non-criminal behavior that can be conducted. Specifically, the state affect variables (i.e., positive, negative, and anger) as well as perceived risk can be examined in relation to either walking away, shoving the guy, or hitting the guy with a bottle.

[65]For transparency and comparison, a MANOVA without trait aggressiveness and the PANAS returned similar estimates. Specifically, the overall model without the covariates was not significant ($p = 0.09$). The presented F-statistic is Wilks' Lambda, for full statistics and comparison please see Appendix D, Supplementary Table S18.

[66]While it could be argued that a single Analysis of Variance (ANOVA) for each outcome variable could have been used, considering the nature of the hypothesis and the fact that the outcome variables were suspected to relate to one another a MANOVA was deemed to be more appropriate. Nonetheless, a 2 (VR vs. Written) x 2 (Depletion vs. Control) ANCOVA was conducted for each outcome variable individually, while controlling for trait aggression and the PANAS – all of which with the exception of "hit the guy with the bottle" returned similar results (Appendix D, Supplementary Table S19). In this case, participants in the Written condition were marginally more likely to hit the guy with the bottle than participants in the VR condition ($M_{vr} = 1.29$ vs. $M_{written} = 1.65$, $M_{diff} = 0.37$, $t(237) = 2.01$, $p_{tukey} = 0.04$, $d = 0.34$, 95% CI [0.00, 0.66]). However, given the small number within the respective cell for each condition and the fact that the confidence interval contains zero, this result should be taken with caution.

Additionally, although the research presented here failed to find an interaction effect on criminal decision-making, main effects of using VR to assess criminal decision-making have been observed. Specifically, using the same stimulus as in this study, Van Gelder and colleagues (2019) observed that participants in the VR condition indicated more intention to aggress than participants in the control condition, but this relationship was serially-mediated by presence and state anger. That is, participants in the VR condition indicated more presence, which in turn lead to an increase in experienced anger, and thus a greater intention to aggress. This relationship held while controlling for other key demographic and theoretically relevant correlates.[67] As such, in this exploratory analyses section I first examined the relationship between various predictors (i.e., perceived risk, negative affect, positive affect, and state anger) in relation to aggressive behavior. I then turn my attention to examining the indirect effects of being in the VR condition on aggressive behavior.

As a first step, all variables of interest were correlated with one another. As displayed in the correlation matrix (Table 13), as one would anticipate the Likert-items for the 'just walk away' was negatively related to both 'shoving the guy' and 'hitting the guy with the bottle' (r_{shove} = -0.54, r_{bottle} = -0.49, both $p < 0.001$). Conversely, the two aggressive behaviors were positively related ($r = 0.41$, $p < 0.001$). In regard to the predictors assessed after the hypothetical scenario, perceived risk was positively related to 'just walk away' ($r = 0.18$, $p = 0.005$) and negatively related to both 'shoving the guy' ($r = -0.18$, $p = 0.004$) and 'hitting the guy with a bottle' ($r = -0.21$, $p = 0.001$). As one would anticipate, state anger was negatively related to 'just walk away' ($r = -0.25$, $p < 0.001$) and positively related to both 'shoving the guy' ($r = 0.33$, $p < 0.001$) and 'hitting the guy with a bottle' ($r = 0.18$, $p = 0.004$). Interestingly, presence held a significant negative relationship with 'just walk away' ($r = -0.13$, $p = 0.04$) and significant positive relationship with 'shove the guy' ($r = 0.29$, $p < 0.001$), but was not significantly related to 'hit the guy with a bottle' ($p = 0.70$). Additionally, realism held a significant positive relationship with 'shove the guy'($r = 0.20$, $p = 0.001$) but was not significantly related to 'just walk away' ($p = 0.17$) nor 'hit the guy with a bottle' ($p = 1.00$). Presence and realism were significantly positively correlated ($r = 0.56$, $p < 0.001$).

[67]The same serial mediation did not occur when presence was replaced with realism, supporting the notion that being present within the scenario is a unique driver.

Surprisingly, positive affect did not hold a significant relationship with any of the outcome variables. Moreover, negative affect did not hold the previously observed (Chapter Three) negative relationship with positive affect (r = -0.02, p = 0.81), nor the traditionally observed positive correlation with risk (r = 0.11, p = 0.09) but did observe a strong positive correlation with state anger (r = 0.68, p < 0.001). Additionally, negative affect did not hold a significant relationship with 'just walk away' but did hold a significant positive relationship with both 'shove the guy' (r = 0.23, p < 0.001) and 'hit the guy with the bottle' (r = 0.18, p = 0.004). As such, it does not appear that neither the negative nor positive state affect variables were behaving in the same way as traditionally observed.

Finally, as trait aggressiveness and the PANAS scale significantly differed between participants (Table 10 and 11) they were also included in the correlation matrix. As can be seen in table 13, trait aggressiveness was significantly negatively related to 'just walk away' (r = -0.33, p < 0.001) and positively related to both aggressive behaviors (r_{shove} = 0.40, r_{bottle} = 0.36, both p < 0.001). The negative subscale of the PANAS was negatively related to 'just walk away' (r = -0.15, p = 0.02) and positively related to 'shove the guy' (r = 0.21, p < 0.001) as well as 'hit the guy with a bottle' (r = 0.22, p < 0.001). The positive subscale of the PANAS was significantly positively related to 'shove the guy' (r = 0.14, p = 0.03) but held no relationship with 'just walk away' (p = 0.79) nor 'hit the guy with a bottle' (p = 0.94).

Table 13

Correlation Matrix and Descriptives for Combined Sample (N = 244)

	Just walk away	Shove the guy	Hit the guy with a bottle	Trait Aggressiveness	PANAS – Negative	PANAS – Positive	Presence	Realism	Risk	Affect: Positive	Affect: Negative	Affect: Anger
Just walk away	-											
Shove the guy	-0.54***	-										
Hit the guy with a bottle	-0.49***	0.41***	-									
Trait Aggressiveness	-0.33***	0.40***	0.36***	-								
PANAS: Negative	-0.15*	0.21***	0.22***	0.40***	-							
PANAS: Positive	-0.02	0.14*	0.00	0.09	0.04	-						
Presence	-0.13*	0.29***	0.02	0.12	0.00	0.25***	-					
Realism	-0.09	0.20**	-0.00	-0.00	-0.03	0.25***	0.56***	-				
Risk	0.18*	-0.18**	-0.21**	-0.20**	-0.21**	0.03	-0.08	0.07	-			
Affect: Positive	-0.04	0.10	0.12	0.20**	0.25***	0.19**	0.12	-0.07	-0.29***	-		
Affect: Negative	-0.12	0.23***	0.18**	0.24***	0.37***	0.19**	0.30***	0.22***	0.11	-0.02	-	
Affect: Anger	-0.25***	0.33***	0.18**	0.29***	0.19**	0.21***	0.36***	0.31***	0.05	-0.09	0.68***	-

Notes: The variables: Just walk away, Shove the guy, and Hit the guy with a bottle, are the three relative Likert-items assessing the likelihood for each behavior. The dotted line divides the dependent variables (left side) and independent variables (right side)

* $p < .05$; **$p < .01$; *** $p < .001$

Logistic Regression

To assess the predictor variables in this study in relation to aggressive and non-aggressive behavior, four regressions were conducted. Specifically, a logistic regression was used in which the dependent variable was the discrete dependent variable. As with the analysis above, if participant chose to "just walk away" they received a score of 0, while if a participant chose to "shove the guy" or "hit the guy with a bottle", they received a score of 1.[68] Secondly, three linear regressions were used in which the dependent variable was the Likert-scale item assessing the likelihood of 'just walk away', 'shove the guy', and 'hit the guy with the bottle', respectively. Each model was built hierarchically following: 1) the condition a participant was in, 2) presence and realism, 3) perceived risk, positive affect, negative affect, as well state anger, and 4) controls including trait aggressiveness and the PANAS. Variables were first standardized to aid in interpretation and comparison.

As can be seen in Table 14, in the base model (Model 1) which only included the condition a participant was in, the model is not significant ($p = 0.694$), none of the conditions were more or less likely to choose to shove or hit the guy with a bottle relative to the Written-Control condition, and the predictive accuracy of the model was no better than chance (Area Under the Curve [AUC] = 0.53).[69,70] By including presence and realism (Model 2; Table 14) the model is significant ($\chi^2(5) = 20.60$, $p < 0.001$), has a greater than chance classification rate (AUC = 0.68), and outperforms the model that only includes the condition a participant was in ($\chi^2(2)$ 19.20, $p < 0.001$). Specifically, presence is positively related to the odds of shoving or hitting the guy with a bottle (OR = 1.99, 95% CI [1.36, 2.90], $p < 0.001$) but realism was not significantly related ($p = 0.86$). That is, for every one standard deviation increase in subjective presence, the odds of indicating an aggressive behavior also increased. Interestingly, the results indicate that participants in the VR-Depletion condition were significantly less likely to choose to shove or hit the guy with a bottle (OR = 0.28, 95% CI [0.10, 0.85], $p = 0.024$; Model 2).

[68]While it could be argued that a multi-nominal or ordinal regression could have been used, due to the small sample size and low number of counts for each dependent variable cell, such an analysis would be improper.
[69]The AUC statistic is a performance indicator that indicates how well a model discriminates between cases. In this analysis, how well the model correctly identifies participants chose to walk away (0) versus those that chose to shove or hit the guy with a bottle (1). In general, AUC scores around 0.50 indicate the model performs no better than chance, whereas scores of 0.70 to 0.79 are considered acceptable, scores of 0.80 to 0.89 are considered good, and scores of 0.90 or higher consider excellent (e.g., Mandrekar, 2010; Rice & Harris, 2005).
[70]An additional model in which condition was dummy coded (1=VR-depletion, 0 = all other conditions) was conducted and returned very similar estimates in regard to model fit and non-significance (Appendix D, Supplementary Table S20).

Table 14

Logistic Regression of Non-criminal (0) and Criminal (1) Behavior

Predictor	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)	Model 4 OR (95%CI)
Condition (Written-Control)		Reference		
VR-control	0.86 (0.33, 2.21)	0.47 (0.17, 1.29)	0.78 (0.26, 2.34)	1.06 (0.25, 3.27)
VR-depletion	0.57 (0.21, 1.56)	0.28* (0.10, 0.85)	0.41 (0.13, 1.30)	0.47 (0.14, 1.59)
Written-depletion	1.00 (0.56, 1.77)	0.98 (0.54, 1.78)	0.95 (0.50, 1.80)	1.09 (0.55, 2.17)
Presence	-	1.98*** (1.36, 2.90)	1.53 (1.00, 2.34)	1.50 (0.96, 2.33)
Realism	-	0.97 (0.69, 1.35)	0.99 (0.69, 1.44)	1.08 (0.73, 1.61)
Perceived Risk	-	-	0.52*** (0.38, 0.72)	0.56*** (0.39, 0.79)
Positive Affect	-	-	1.08 (0.79, 1.48)	0.98 (0.70, 1.38)
Negative Affect	-	-	0.93 (0.63, 1.39)	0.87 (0.56, 1.37)
State Anger	-	-	2.09*** (1.35, 3.26)	1.84** (1.17, 2.89)
Trait Aggressiveness	-	-	-	2.03*** (1.40, 2.94)
PANAS – Negative	-	-	-	0.94 (0.65, 1.36)
PANAS – Positive	-	-	-	0.96 (0.69, 1.35)
Constant	0.62* (0.45, 0.93)	0.68 (0.44, 1.04)	0.57* (0.36, 0.91)	0.50** (0.31, 0.82)
N	244	244	244	244
Likelihood Ratio χ^2 (df)	(3) = 1.45	(5) = 20.60***	(9) = 51.65***	(12) = 67.65***
McFadden's R^2	0.00	0.06	0.16	0.21
Deviance	320	301	270	254
AIC	328	313	290	280
Sensitivity	0.00%	23.30%	52.20%	52.20%
Specificity	100%	88.30%	86.40%	87.70%
AUC	0.53	0.68	0.76	0.80
VIF (Range)	1.00	1.03 – 1.20	1.04 – 1.36	1.05 – 1.39
Difference from previous model χ^2 (df)	-	(2) = 19.20***	(4) = 31.00***	(3) = 16.00***

Notes: When assessing multicollinearity, there is a moderate to strong correlation between state anger and negative state affect (r = 0.68; Table 13); however, the relative standard error in the logistic regression for both variables was small (Model 4; ~0.03) and the VIF was low (1.35 and 1.39, respectively). Taken collectively, it is reasonable to conclude that there is no multicollinearity present.

* $p < .05$; ** $p < .01$; *** $p < .001$

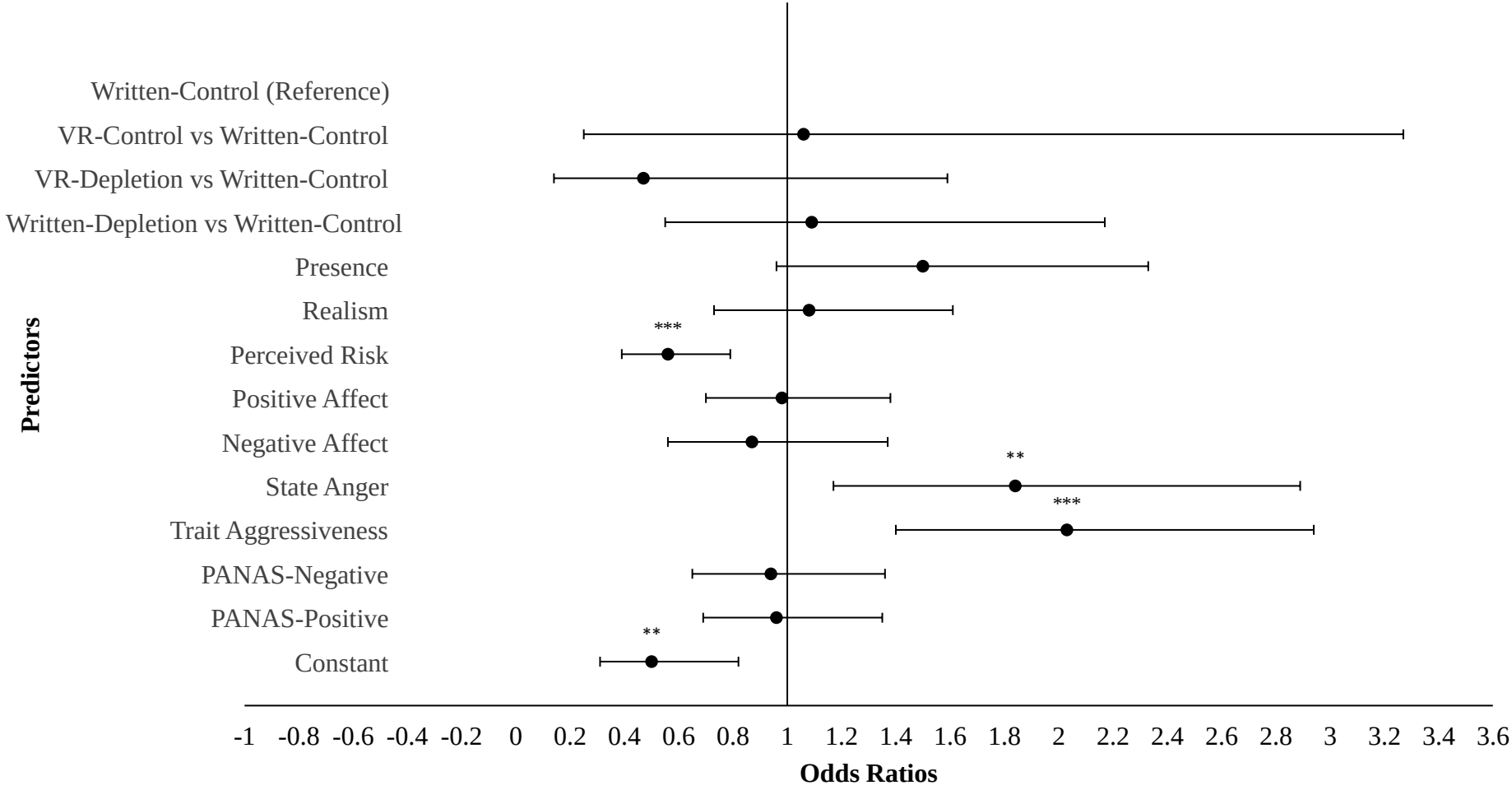
Model 3, which includes perceived risk, positive affect, negative affect, and state anger is significant ($\chi^2(9) = 51.65$, $p < 0.001$; Table 14), outperforms Model 2 (Table 14; $\chi^2(4) = 31.00$, $p < 0.001$), and has an acceptable classification rate (AUC = 0.76). Of the new predictor variables, only perceived risk and state anger are significant. Specifically, perceived risk was significantly negatively related to the odds of choosing to shove or hit the guy with a bottle (OR = 0.52, 95% CI [0.38, 0.72], $p < 0.001$) while state anger was positively related to the odds of choosing to shove or hit the guy with a bottle (OR = 2.09, 95% CI [1.35, 3.26], $p < 0.001$). By including these factors, being in the VR-Depletion condition and presence are no longer significantly related to the odds of choosing to shove or hit the guy with a bottle.

Finally, Model 4 (Table 14) which included controls was significant ($\chi^2(12) = 67.65$, $p < 0.001$), outperformed Model 3 ($\chi^2(3) = 16.00$, $p < 0.001$), and had a good classification rate (AUC = 0.80). Specifically, trait aggressiveness was significantly positively related to the odds of choosing to shove or hit the guy with a bottle (OR = 2.03, 95% CI [1.40, 2.94] $p < 0.001$). Additionally, perceived risk (OR = 0.56, 95% CI [0.39, 0.79], $p < 0.001$) and state anger (OR = 1.84, 95% CI [1.17, 2.89]) remained significantly related to the odds of choosing to shove or hit the guy with a bottle. Finally, neither the positive ($p = 0.819$) nor negative (0.752) subscales of the PANAS were significantly related to the odds of choosing to shove or hit the guy with a bottle.

To summarize, there was no main effect of condition on the odds of choosing to shove or hit the guy with a bottle. However, there was consistent support for a negative relationship between perceived risk and the odds of choosing to shove or hit the guy with a bottle. Specifically, in both Models 3 and 4, for every one standard deviation increase in perceived risk, the odds of selecting an aggressive behavior decreased. Conversely, there was a consistent positive relationship between state anger and the odds of choosing to shove or hit the guy with a bottle. That is, in both Models 3 and 4, for every one standard deviation increase in state anger, the odds of selecting an aggressive behavior increased. Finally, trait aggressiveness was significantly positively related to the odds of choosing to shove or hit the guy with a bottle. The odds ratio for each predictor in the final model (Model 4; Table 14) can be found below in Figure 12.

Figure 12

Odds Ratios of Indicating Shoving or Hitting a Guy with a Bottle



Note. Error bars represent 95% CIs. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Linear Regressions

Next, as a robustness check to the above logistic regression, the same analyses were conducted using three linear regressions with the individual Likert-items of the outcome variables (i.e., Walk away, Shove the guy, and Hit the guy with the bottle) as the dependent variables. As with the logistic regressions above, models were built hierarchically with the steps being: 1) condition, 2) presence and realism, 3) perceived risk, negative affect, positive affect, as well as state anger, and 4) trait aggressiveness and the PANAS.

In line with the results of the logistic regression above, for all outcome variables (i.e., Just Walk Away, Appendix D; Supplementary Table S21; Shove the Guy, Appendix D; Supplementary Table S22; and Hit the Guy with a Bottle, Appendix D; Supplementary Table S23) the condition a participant was in (Model 1) was non-significant. Additionally, model fit continually improved with the best model including trait aggressiveness and the PANAS (Model 4). As such, the results presented here are for the final full model (Model 4) for each outcome variable.[71]

Regarding predictors, as one would anticipate from the results of the correlation matrix and logistic regression, trait aggressiveness was the most consistent predictor. Specifically, trait aggressiveness was significantly negatively related to the likelihood of walking away (β = -0.24, 95% CI [-0.38, -0.10], $p < 0.001$; Appendix D; Supplementary Table S21), and significantly positively related to the likelihood of shoving the guy (β = 0.30, 95% CI [0.17, 0.43], $p < 0.001$; Appendix D; Supplementary Table S22) as well as the likelihood of hitting the guy with a bottle (β = 0.28, 95% CI [0.15, 0.42], $p < 0.001$; Appendix D; Supplementary Table S23). Similarly, state anger was significantly negatively related to walking way (β = -0.20, 95% CI [-0.38, -0.03], $p = 0.025$; Appendix D; Supplementary Table S21), and significantly positively related to shoving the guy (β = 0.17, 95% CI [0.01, 0.34], $p = 0.042$; Appendix D; Supplementary Table S22). There was no significant relationship between state anger and the likelihood of hitting the guy with a bottle ($p = 0.639$). Interestingly, risk was significantly negatively related to the likelihood of hitting the guy with a bottle (β = -0.15, 95% CI [-0.27, -0.02], $p = 0.027$; Appendix D; Supplementary Table S23), but was not significantly related to the likelihood of walking away ($p = 0.067$) nor shoving the guy ($p = 0.086$).

[71]For a comparison of a model with and without covariates please see Appendix D, Supplementary Table S21, S22, and S23.

Additionally, presence was significantly positively related to the likelihood of shoving the guy (β = 0.18, 95% CI [0.02, 0.33], p = 0.031; Appendix D; Supplementary Table S22).

To summarize, as with the logistic regression there was no main effect of condition on any of the outcome variables when individually assessed. As one would anticipate, state anger was positively related to the likelihood of shoving the guy and negatively related to the likelihood of walking away. That is, as one's state anger increased, they were less likely to walk away and more likely to shove the guy. Trait aggressiveness was the most robust finding being positively related to the likelihood of both shoving the guy and hitting the guy with a bottle but negatively related to the likelihood of walking away. Risk was only significantly related to the likelihood of hitting the guy with a bottle. Specifically, as perceived risk increased the likelihood of hitting the guy with a bottle decreased. There was no significant relationship between perceived risk and walking away or shoving the guy. Finally, it must be explicitly stated due to the small sample size and resulting underpowered analyses, the multivariate normality as well as homoskedasticity assumption for the models were violated (Appendix D, Supplementary Table S21, S22, S23; Appendix E, Supplementary Figures S21 – S23).

Serial Mediation Analyses

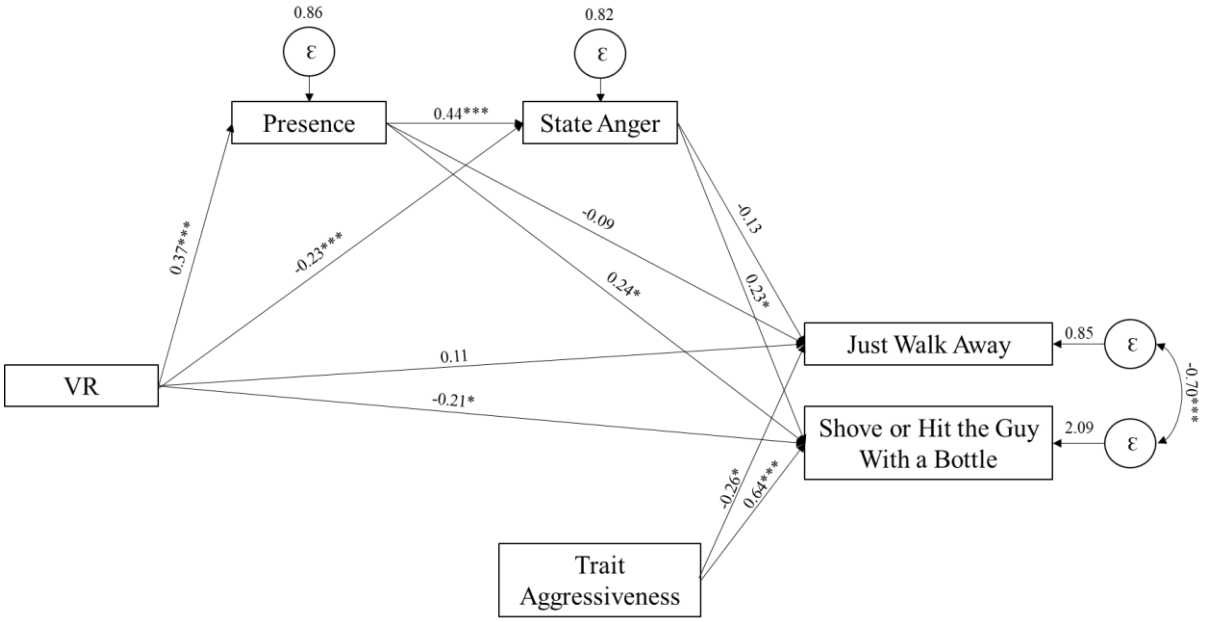
As a final exploratory analysis, I sought to determine if the serial mediation observed by previous research (i.e., Van Gelder et al., 2019) could be found using conceptually similar yet different outcome variables. Specifically, I examined if being in the VR condition had significant indirect positive relationship with the likelihood of shoving or hitting the guy with a bottle. This indirect relationship is proposed to be mediated by presence and state anger. That is, being in the VR condition increases presence, which increases state anger, and in turn increases the likelihood of shoving or hitting the guy with a bottle. Additionally, I also sought to determine if the same serial mediation was found for non-aggressive, law-abiding behavior to a similar degree, (albeit in the opposite direction). To accomplish this, a simple path analysis was conducted.

To achieve this, similar to the logistic regressions above, two Likert outcome variables were used. Specifically, one variable was the likelihood of walking away on a 1 (Not at all likely) to 7 (Very likely) scale and the other was the summation of the likelihood of shoving the guy and hitting the guy with a bottle. As the variables were observed to correlate with one

another, their error terms were allowed to correlate in the model. The primary independent variable was whether a participant was or was not in VR condition (0 = written; 1 = VR). The variables Presence and State Anger were input as mediators between being in the VR condition and the likelihood of walking away as well as the likelihood of shoving or hitting the guy with a bottle. Additionally, as a trait aggressiveness was significantly related to the outcome variables in all of the analyses presented above, it was controlled for in the model. Finally, to control for the ego-depletion manipulation, analyses were conducted at the group level (i.e., depletion vs. control) constraining all parameters to be equal. Model fit was not significantly different between an unconstrained model and fully constrained model ($\chi^2(20) = 21.69$, $p = 0.357$). As such, the path coefficients discussed below are for participants that were and were not depleted (Figure 13).

Figure 13

Serial Mediation of Virtual Reality on Intention to Aggress



Notes. The presented coefficients are standardized. The variable VR is dummy coded (0 = written; 1 = VR). To control for the ego-depletion manipulation analyses were conducted at the group level constraining all parameters to be equal. Model fit was not significantly different between an unconstrained model and fully constrained model ($\chi^2(20) = 21.69$, $p = 0.357$). As such, the path coefficients presented are for participants that were and were not depleted. Model fit: χ^2 (24) = 47.89, $p = 0.003$, RMSEA = 0.09 95% CI [0.05, 0.13], CFI = 0.92, TLI = 0.90, SRMR = 0.09. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Overall, model fit was acceptable ($\chi^2(24) = 47.89$, $p = 0.003$, RMSEA = 0.09 95% CI [0.05, 0.13], CFI = 0.92, TLI = 0.90, SRMR = 0.09; Figure 13). In regard to direct effects, trait aggressiveness was significantly positively related to the likelihood of shoving or hitting the guy with a bottle (β = 0.64, 95% CI [0.44, 0.83], $p < 0.001$) and significantly negatively related to the likelihood of walking away (β = -0.26, 95% CI [-0.38, -0.14], $p < 0.001$). State anger was significantly positively related to the likelihood of shoving or hitting the guy (β = 0.23, 95% CI [0.02, 0.43], $p = 0.03$) but not significantly related to the likelihood of walking away ($p = 0.06$). Similarly, presence was significantly positively related to both the likelihood of shoving or hitting the guy (β = 0.24, 95% CI [0.02, 0.45], $p = 0.03$) and state anger (β = 0.44, 95% CI [0.32, 0.57], $p < 0.001$), but held no significant relationship with the likelihood of walking away ($p = 0.180$). Finally, being in the VR condition held a significant positive relationship with presence (β = 0.37, 95% CI [0.26, 0.49], $p < 0.001$), held a significant negative relationship with state anger (β = -0.23, 95% CI [-0.36, -0.11], $p < 0.001$), and a marginally significant negative relationship with the likelihood of shoving or hitting the guy (β = -0.21, 95% CI [-0.41, -0.00], $p = 0.05$). However, there was no significant relationship between being in the VR condition and the likelihood of walking way ($p = 0.102$).

In regard to indirect effects, being in the VR condition had a significant positive indirect relationship with state anger (β = 0.17, 95% CI [0.10, 0.23], $p < 0.001$; but no significant indirect relationship with neither the likelihood of walking away ($p = 0.391$) nor the likelihood of shoving or hitting the guy with a bottle ($p = 0.146$). Presence had a significant positive indirect relationship with likelihood of shoving or hitting the guy with a bottle (β = 0.10, 95% CI [0.01, 0.20], $p = 0.04$) but no indirect relationship with the likelihood of walking away ($p = 0.06$). Finally, in regard to total effects on the outcome variables, presence was significantly negatively related to the likelihood of walking away (β = -0.15, 95% CI [-0.28, -0.02], $p = 0.02$) and significantly positively related to the likelihood of shoving or hitting the guy with a bottle (β = 0.34, 95% CI [0.14, 0.54], $p < 0.001$). Conversely, the total effect of being in the VR condition was not significantly related to neither walking away ($p = 0.178$) nor shoving or hitting the guy with a bottle ($p = 0.167$).

To summarize, as with the previous analyses trait aggressiveness had the most robust relationship being negatively related to walking away and positively related to the aggressive outcomes. The results regarding the serial mediation of VR (i.e., VR increases presence, which increases state anger, and in turns increases aggression) were inconclusive. Specifically, while

there was a direct positive relationship between VR and presence, and a significant positive indirect effect of VR on state anger (mediated by presence), there was no significant indirect effect on either outcome variable. However, as discussed below due to the limited sample size ($N_{vr} = 46$), these results should be taken with caution and I sought to expand on this model with a greater sample size in Chapter Five.

Discussion

The main purpose of this study was to add to the developing literature exhibiting the pragmatism of using VR to study criminal behavior, specifically regarding presence, realism, and overall ecological validity. It was theorized that because traditional written vignettes are detached from reality, they limit our ability to detect potentially important effects within the laboratory, in this case ego-depletion increasing aggressive behavior. The analyses presented here support the notion that participants in the VR condition indicate more presence, and arguably more realism. Specifically, using a wide range of analyses VR participants consistently indicated a greater level of subjective presence whereas the results were less conclusive regarding realism (e.g., the confidence interval for the Cohen's *d* for this relationship included zero). Thus, support is found for Hypothesis 1 but not for Hypothesis 2. Participants within the VR-Depletion group were no more likely to indicate an aggressive response than other participants, neither as discrete nor Likert-style variable. As such, null Hypothesis 3 is retained. However, with such an underpowered sample as a result of interruption due to COVID-19 (see limitations below), it would be inappropriate to draw firm conclusions in (dis)favor of any of these findings. Nonetheless, there are several consistent findings from the exploratory analyses that deserve attention and are discussed alongside the main hypotheses below.

Presence and Realism

Consistent with previous literature using the same VR module and comparison group design (i.e., Van Gelder et al., 2019), participants in the VR condition indicated greater amounts of presence than participants in the control condition. Additionally, participants descriptively indicated more realism than participants in the written condition, but to a lesser extent than presence ($d_{realism} = 0.28$, $p = 0.05$; $d_{presence}$ 1.02, $p < 0.001$). The difference in magnitude between presence and realism is that unlike presence, realism is not as explicitly

influenced by the medium a vignette is delivered in. That is, how realistic one believes a hypothetical scenario to be may not differ as a function of how it is presented, but of the content (Van Gelder et al., 2019). As vignettes are explicitly designed to be realistic, and the content of the scenario was the same across conditions, only a small difference is perhaps understandable. Informal feedback from a number participants in the VR condition highlighted how realistic they found the scenario, how captivated they were, and how it was 'weird to come back to the real world' afterwards. While it is not possible to compare such feedback to the written group, statements such as these indicate VR puts participants within a realistic scenario and increases presence.

VR and Depletion on Criminal Decision-making

In regard to the amount of aggressive behavior displayed, neither results of a MANOVA, logistic regression, (1 = aggressive behavior), individual linear regression, nor SEM indicated that participants in the VR-Depletion condition were more likely to choose an aggressive behavior, neither as a discrete option nor as a continuous likelihood variable with and without covariates. In the only instance that there was a difference in outcome variable by condition it was in the opposite direction. Specifically, participants in the written condition indicated that they would be more likely to hit the guy with a bottle than participants in the VR condition ($M_{vr} = 1.29$ vs. $M_{written} = 1.65$, $M_{diff} = 0.37$, $t(237) = 2.01$, $p_{tukey} = 0.04$, $d = 0.34$, 95% CI [0.00, 0.66]). However, given the small sample size and that the confidence interval contains zero, this result should be taken with caution.

Regardless, this finding encompasses two interesting paradigms that warrant future research. The finding that medium of delivery (i.e., VR vs. written) may result in different levels of indicated criminal behavior suggests that methodology may influence the intention-behavior gap. That is, neither VR nor written vignettes are real-world behavior, and thus the relative indicated behavior is still an *intention*. Recognizing the possibility that neither VR nor written vignettes may perfectly predict real-world behavior, it is important that we assess how intended behaviors will differ based on how the vignette is presented. That is, it is important to know if a participant's indicated behavior will differ based on if they simply read or experience the vignette in VR. Behavior intentions that differ based on methodology may skew or misinform any resulting theory. As such, to have as accurate of a theory as possible, it is

important to have a clear understanding as to how these methodologies differ in regard to intended behaviors.

Additionally, what drives the intended behavior may also differ between how vignettes are presented. That is, as with the observed serial mediation of aggressive behavior by presence and anger in Van Gelder and colleagues' study (2019), the reasons for why participants may differ in their selected behaviors may be because they experience the scenario rather than simply read it. Complementing these findings, informal feedback from some participants in the current study indicated that the reason they chose to shove the guy was because they physically saw him. For example, participants stated:

> "I wouldn't have shoved him if I had been reading the scenario – because I would have been further away mentally from it, ya know? I would have handled it intellectually, but because I saw him, and saw him imposing, I wanted to shove him".

> "I shoved him because I see so many guys like that on a night out and I am just sick of them".

If VR is in a position to become a more normative or mainstream research tool, it is essential that researchers are aware of such potential differences and have an accurate framework to capture them.

Exploratory Analyses Discussion

Main Effects of Predictors

In addition to the hypothesized relationships, the main effects of perceived risk, negative affect, state anger, and trait aggressiveness were examined. The most robust finding was that of trait aggressiveness, which was consistently positively related to both aggressive outcomes and negatively related to the 'just walk away' option. This aligns with the greater literature that shows that trait aggression is positively related to criminal behavior (Falk et al., 2017; Huesmann et al., 2009; Wells et al., 2011) and highlights a potential important distal factor for predicting law-abiding behavior. Similarly, state anger was negatively associated

with the likelihood of walking away and positively associated with the likelihood of shoving the guy. Conversely, although perceived risk was consistently negatively associated with aggressive behavior, the positive relationship with walking away was less consistent. These results highlight that while some predictors may associate with both law-abiding behavior and criminal behavior, other predictors (e.g., perceived risk) may be better predictors of only criminal behavior and may not predict law-abiding behavior to a similar degree. Nonetheless, as highlighted throughout this chapter, the small sample size and exploratory nature of these analyses need to be considered.

Additionally, in the logistic regression perceived risk (a traditional proximal variable), state anger (an affective proximal variable), and trait aggressiveness (a distal variable) were all significant predictors of the odds of a participant selecting to shove or hit the guy with the bottle. This result aligns with the previous chapters which indicate to create an accurate criminal decision-making model we must include: individual differences (in this case trait aggressiveness), cognitive decision-making factors (e.g., perceived risk), as well as affective parameters (e.g., state anger; McClanahan et al., 2019; McClanahan & van der Linden, 2020).

Interestingly there was no influence of negative nor positive affect on criminal choice. This null effect for negative affect may be due to its high correlation with state anger ($r = 0.68$). Thus, in a full model, anger may superseded the effects of negative affect.[72] As with the results presented in Chapter Three, this suggests that future research needs to examine what types of emotions are influential in decision-making in what type of situations. This would require a refinement of theory from a simple positive-negative dichotomy to something more directly related to behavior (i.e., approach versus avoidance; Lerner, Li, Valdesolo, & Kassam, 2015) or specific to certain situations (e.g., anger in criminal opportunities arising from provocation).

Serial Mediation

Regarding the mediation analysis, there does appear to be some form of an indirect effect present. Specifically, participants in the VR condition indicated a greater presence, which in turn lead to a greater amount of state anger, which then lead to an increased likelihood of shoving or hitting the guy. Although there was a significant positive indirect effect of being in

[72]None of the models displayed indicators of multicollinearity.

the VR condition on state anger (mediated by presence), there was no overall significant indirect effect of being in the VR condition on the likelihood of shoving or hitting the guy with a bottle. Being in the VR condition had a significant negative direct effect on the likelihood of shoving or hitting he guy with a bottle (β = -0.21, 95% CI [-0.41, -0.00], p = 0.05). However, the total effect was non-significant (p = 0.146). Although nonsignificant, this is likely due to the indirect effect being in the opposite direction of the direct effect (β = 0.07, p = 0.146) and the direct effect only being marginally significant (p = 0.05). The same pattern is observable between the direct and indirect effects of being in the VR condition on state anger. The former is significantly negative while the latter is significantly positive resulting in the total effect being nonsignificant (p = 0.283). However, considering the small sample size, particularly in the VR condition (N = 46) these results should not be emphasized, and I sought to expand on this model with a greater sample size in the following chapter.

Limitations

While the results of this study are interesting and provide a useful framework for future research using VR to build on, they are not without their limitations. Firstly, as noted throughout the chapter, due to COVID-19 interruption this study is underpowered. Specifically, for main effects of condition (i.e., VR versus Written) on presence, realism, and criminal intention, analyses were operating at 79%, 52%, and 30% power, respectively. As such, any results presented here should be taken with caution. Moreover, those participants in the VR condition were on average younger and more likely to be full-time students than participants in the written condition. As a simple robustness check, all main analyses were conducted using a sample that was matched to ensure the average age was nor the modal response for other demographic variables were not significantly different between conditions (Appendix D, Supplementary Table S24). A χ^2 analysis, MANOVA, and logistic regression model all returned very similar estimates (Appendix D, Supplementary Table S25, S26, S27). Additionally, a matched sample model returned very similar estimates for the individual linear regressions (Appendix D, Supplementary Table S28-S30). However, in instances where the predictor was only marginally significant in the model with the full sample, (e.g., p = 0.040 – 0.049) the predictor was no longer significant in the matched sampled model (i.e., confidence interval contains 0). This is likely due to the decrease in sample size.

While VR is considered to be an improvement to traditional written vignettes, the methodology is not without its limitations. Most notably, participants must be willing to suspend their disbelief and become immersed in the presented scenario. That is, simply exposing a participants to a VR stimulus does not automatically make them fully engrossed in the scenario. Instead, participants must still be willing to suspend their disbelief and place their focus on the virtual rather than physical world. There are several reasons, both internal to participants and external to the VR stimulus itself, that may influence or interrupt a participant's suspended disbelief, and thus potentially reduce subjective presence and realism (e.g., Waterworth & Waterworth, 2001). For example, current VR systems do not provide olfactory information to participants and may not include physical sensory feedback such as touch. This in turn may reduce a participant's ability to feel fully engrossed into the virtual environment. As another example, internet connectivity issues were present for two participants in this chapter in which 'buffering' occurred. Such buffering or interrupted playback of the module may have interrupted the participant's suspended disbelief and reduced presence and realism (Bailenson, 2018). Additionally, participants could have been mentally elsewhere (e.g., consumed with thoughts of the day) and thus less engrossed in the virtual world, reducing presence and realism.

Furthermore, although the module was interactive (i.e., participants could choose what they wanted to do), they did not have control over the verbal exchange between the protagonist (their view) and antagonist. As such, some participants indicated that they felt they would have handled the situation differently from the beginning by not saying the things that the protagonist said or walking away and not even engaging in a discussion with the antagonist to begin with. Similarly, some participants stated that while they chose to just walk away, they would have chosen a more aggressive *verbal* response if it was available and taken it from there. These factors culminate in the limited iterations an interactive module may have.

In this chapter, the discrete option choices provided were driven by the available VR stimulus. That is, the options to shove and hit the guy with the bottle were chosen because the video to display this option was available. By providing participants the ability to select and see their chosen behavior occur in the VR module, I aimed to increase presence and realism. However, had I not limited myself to the video stimulus available, and had not been concerned with the ability for the behavior to play out, I could have included other behaviors, such as the more aggressive verbal response that participants indicated they would have chosen. While

researchers may create a more interactive module, with a continuous branching narrative with *N* number of potential iterations, doing so would be resource intensive. Methodologically, as VR equipment becomes more readily available, researchers may be interested in examining the minimum number of permutations within a branching narrative required to maximize presence and realism, without causing participant fatigue or requiring too many resources.

More specifically to this study, the selected dependent variables could have influenced what participants chose. Specifically, the measure of criminal behavior differed from previous research in regard to context and method. For example, in their study, Van Gelder and colleagues asked participants two questions regarding the likelihood that they would "use violence against this person by pushing, kicking or hitting him?" (2019, p. 461). Moreover, as discussed in the Measurements section above, this was assed using only Likert-items, with a time delay. Conversely, in this study participants were asked the likelihood of engaging in shoving the antagonist, hitting him with a bottle, and simply walking away. This was assessed both discretely and as individual Likert-items. Although the results within this study complement one another (i.e., the relationships between predictors and outcomes are similar when comparing the discrete to Likert variables), it is possible that had the same outcome variable been used as in the Van Gelder study (2019) different results may have been observed.

It should also be noted that the chosen virtual reality stimulus was created with Dutch actors speaking English, but lacking an English accent. Although unavoidable in this case, it is possible that such deviations from expectations (i.e., an English participant would expect to hear an English accent from their avatar) may potentially modify the experienced presence and realism. Similarly, in their original article, Van Gelder and colleagues (2019) observed a significant difference in the perceived attractiveness of the girlfriend Lisa by condition. Specifically, participants in the written condition that had to impose their own image of Lisa found her to be more attractive than participants in the VR condition that were provided the image of Lisa. Although there was a mean difference, the attractiveness of Lisa was not reported to predict intention to aggress. Therefore, I did not believe it needed to be controlled for. However, this does highlight the importance of imputation or "filling in the blanks" that may arise when comparing VR and written methods. For example, in this scenario there are several parameters that participants in the written condition had to or could impute (e.g., all visual aspects surrounding the pub they are eating in, what the antagonist looked like, and what food was ate for dinner). However, not all may be theoretically or empirically relevant and to

control for and controlling for each would be taxing for participants and arguably impossible. Nonetheless, future researchers should consider what factors must be imputed by written participants and if such imputation may modify anticipated results.

Finally, although the manipulation check that was used in this chapter, Chapter Three, and more generally within the ego-depletion literature (e.g., Schmeichel et al., 2003) supported the notion that participants in the depletion group were successfully depleted, the additional state self-control measure did not reflect this. Specifically, while participants in the depletion condition descriptively indicated less state self-control than participants in the control condition, the difference was small (1.2) with both groups having large Standard Deviations. Exploratory analysis reveals that state self-control and the manipulation checks are negatively correlated (r = -0.23, p = 0.003). That is, as task difficulty increased state self-control significantly decreased. Moreover, a linear regression reveals that the manipulation check is negatively associated with state self-control, even when controlling for the condition a participant was in (β = -0.23, 95% CI [-0.35, -0.10], p < 0.001). This aligns with what one would anticipate from an ego-depletion task: an ego-depletion task is more difficult, which leads to less state self-control.

Nonetheless, this poses a pressing question to the ego-depletion literature, how well does cognitive demand and task difficulty (factors traditionally assessed as manipulation checks for depletion tasks) relate to state self-control levels. While the relationship between task difficulty and state self-control is significant in the expected negative direction, the strength of the relationship is small. Moreover, according to the traditionally used manipulation checks, participants were significantly depleted; however, according to the state self-control measure the results are less conclusive. This discrepancy may lead researchers to conclude that depletion occurred when it actually did not (or vice versa) and that is why a main effect was or was not observed. Going forward, researchers that use an ego-depletion paradigm should ensure to have multiple indicators of successful depletion. Reliance on manipulation checks that only assess cognitive demand may inadvertently lead to the inappropriate conclusion of successful depletion.

Conclusion

Transitioning methodologies from written vignettes to immersive virtual reality holds the possibility for more ecologically valid results and in turn important policy implications. As such, the main aim of this chapter was to examine how presenting a vignette in VR would differ from the traditional written methodology. Although there was no interaction between depletion and condition, participants that experience a vignette in immersive VR indicated a greater subjective presence. Additionally, once again demonstrating the importance of an integrated approach - individual differences (i.e., trait aggressiveness) and proximal factors (i.e., perceived risk and state anger) simultaneously related to criminal behavior. Unfortunately, due to a small sample size the indirect effects of being in the VR condition on aggressive behavior was inconclusive. As such, in the following chapter I sought to extend and expand on the findings of this chapter using a similar methodology with a greater sample size.

Chapter Five: Does Presentation Matter? The Difference Between Virtual Reality and Written Text in assessing Criminal Decision-Making

Due to the previously described COVID-19 interruption the derived sample size resulted in underpowered analysis in Chapter Four. While the previous chapter allowed for interesting exploratory analyses there was a limit on the ability to draw conclusive findings, particularly in regard to a main effect of vignette presentation (e.g., VR vs Written text) on criminal decision-making. As such, using the remaining resources from the previous chapter, in this chapter I sought to follow up and expand on the previous chapter by first establishing if there is a main effect on criminal behavior when using different methods to deliver a vignette. A secondary purpose of this chapter was to examine what parameters are *naturally* considered by participants. Additionally, I examined if such parameters differ based on how the vignette was presented (e.g., through immersive VR or traditional written text). These two aims collectively promote a novel and deeper understanding of how presenting vignettes in different formats may directly and indirectly influence theories of criminal decision-making.

Main Effects of Vignette Presentation on Criminal Decision-making

As discussed in Chapter Four, when using the same VR stimulus used in this doctoral thesis, researchers have observed a main effect on criminal intention. That is, participants which experienced the vignette in immersive VR indicated more criminal behavior than participants which simply read a transcript of the vignette. Moreover, this relationship was observed to be serially mediated by presence and anger. While I was unable to observe the same main effect in Chapter Four,[73] exploratory analyses did indicate that there may be some mediating mechanism present. However, the COVID-19 interruption and resulting small sample size prevents conclusive results from being drawn. Therefore, the primary purpose of this chapter was to establish if criminal decision-making varied based on how the vignette was presented and if this relationship was serially mediated by presence and anger.

[73]Analyses examining only the control groups in Chapter Four (i.e., no depletion) also support this conclusion as a discrete χ^2 analysis and when comparing the Likert outcome variables individually (Appendix D, Supplementary Table S31 and S32).

Predictors of Criminal Decision-making and Vignette Presentation

The second purpose of this study is to get back to the heart of the question of this thesis, why individuals commit crimes. When using hypothetical scenarios to assess criminal decision-making, researchers have traditionally used closed-ended questions that primarily assess the likelihood of apprehension and severity of punishment. As discussed throughout this thesis, while such aspects align with traditional theories as important predictors of criminal decision-making (e.g., Cornish & Clarke, 1986), modern research suggests that participants also consider other factors (e.g., emotions, norms, and heuristics). Compared to traditional factors, these factors may be more influential in their decision-making and better predictors of criminal behavior (e.g., Exum & Bouffard, 2010; McClanahan et al., 2019; McClanahan & van der Linden, 2020; Van Gelder, 2013). Moreover, close-ended responses lend themselves to recognition and require participants to provide information about factors that they may thought trivial or altogether not considered had they not been asked.

Conversely, open-ended questions promote natural recall of salient factors that the participant naturally considers important (Exum & Bouffard, 2010; Schwarz & Hippler, 1990; Schwarz & Oyserman, 2001). In other words, the factors that researchers typically assess when examining criminal decision-making (e.g., perceived risk) may not be the factors participants naturally consider in the moment when making their decision. In a similar vein, as demonstrated with the open feedback in Chapter Four as well as previous research (Van Gelder et al., 2019), some of the reasons for a participant choosing a certain behavior may be influenced by how the vignette is presented. That is, participants may indicate a certain behavioral intention simply because they experience the vignette in VR rather than read it.

Taking these findings collectively, it is possible that participants that experience a vignette in VR will be naturally influenced by factors that: 1) differ from participants that experience the same vignette in written format and 2) differ from what researchers typically examine. Because researchers may use standard closed-ended questions derived from studies assessing vignettes presented in a written format, they may inadvertently miss key components of what factors actually influence a person's decision-making – especially when that person is using VR.

As demonstrated in this thesis (Chapter Four) and broadly throughout the literature (Bailenson, 2018; Francis et al., 2016; Loomis et al., 1999; Niforatos et al., 2020; Patil et al., 2014; Steuer, 1992; Ticknor, 2018; Van Gelder et al., 2014, 2019), as VR increases presence it is suggested to better represent real-life decision-making and behavior. Therefore, the misalignment between what researchers examine and what people *actually* consider may result in incorrectly specified theories and models of criminal decision-making. This may potentially limit the effectiveness of any policies aimed at reducing crime. That is, this misalignment may highlight a boundary condition of the traditional methods of assessing criminal decision-making in relation to either using VR or overall real-world decision-making (e.g., Bacharach, 1989; Busse et al., 2017; Whetten, 1989). To put it simply, using old modes of assessment to examine new methodologies may not replicate well and more importantly may not even accurately represent decision-making nor behavior. Therefore, it is important to examine what factors people naturally consider when making a decision in VR, and if these factors differ from what researchers typically examine.

Collectively, the above literature and previous findings of this thesis indicate that the way the vignette is presented may: 1) influence the level of criminal behavior and 2) influence the factors considered (or not considered) when making a decision. To assess these key methodological questions, an online between-groups study was conducted. While it would be ideal to be able to use VR, due to the previously discussed COVID-19 interruption, in-person testing and the use of VR was not permitted. Instead, and as discussed below in the methods section, the same VR module used in the previous chapter was converted to be displayed in a normal video format. Specifically, a standard vignette scenario was presented either as an embedded video or written text in an online survey.

Most of the procedure mirrored Chapter Four with participants indicating criminal behavior, presence, and perceived realism. However, rather than using researcher-generated, close-ended questions assessing perceived risk, negative affect, positive affect, or perceived benefits, two open-ended questions allowing participants to list all factors they naturally considered were used. Participants' free-response answers were coded using categorization from previous research (i.e., Bouffard, 2002).

The aim of this research was largely exploratory, rather than confirmatory. As such, rather than offering hypotheses, I focused on indicating clear research questions. Specifically:

RQ1: Does criminal choice differ when using a traditional written vignette compared to a video?

RQ2: Does indicated subjective presence and/or realism differ when using a traditional written vignette compared to a video?

RQ3: Do the responses to open-ended questions fit within the framework offered by Bouffard (2002)?

RQ4: If the responses provided by participants do *not* fit within the framework, do they center around other theoretically relevant themes?

RQ5: Of all the responses provided by participants, which hold the strongest association with criminal behavior?

RQ6: Of all the responses provided by participants, do they all fit within a traditional RCT perspective, and if not, how do they compare in regard to association with criminal behavior?

RQ7: Do RQ3-6 differ when using a traditional written vignette compared to a video?

RQ8: Does presence and anger serially mediate the relationship between VR and criminal decision-making?

Method

Participants

Participants were recruited through the online crowdsourcing platform, Prolific Academic (Peer et al., 2017). In total, 359 participants (N_{video} = 177, $N_{written}$ = 182) completed the study.[74] As with Chapter Four, due to the nature of the hypothetical scenario, in order to participate, participants had to self-identify as a man and be bi- or heterosexual. Additionally, as half of the participants would be required to watch a video with audio, participants were also required to have normal or corrected-to-normal hearing. As the video was embedded to a specific size, participants were required to use a desktop or laptop, rather than a mobile phone. Finally, participants that participated in the previous study (Chapter Four) were not allowed to

[74]As discussed in greater detail below in the limitations section, the sample size was derived from resource availability and convenience.

participate in the study presented here.[75] All participants identified as male and were either bi- or heterosexual (Table 15).

Table 15

*Sample Characteristics (*N = *359)*

Characteristic	Mean or Modal Response
N	359
Sex	100% Male
Age	*M* = 26 (*SD* = 8)
Ethnicity	Modal Response (88%) - White
Employment Status	Model Response (43%) – Full-time student
Education	Modal Response (66%) – Undergraduate or Higher
Marriage Status	Modal Response (59%) - Single

Procedure

All participants were recruited through the online labor crowdsourcing platform, Prolific Academic (Peer et al., 2017). As with previous chapters, a standard ad (Appendix A, Advertisement 6) was published on the Prolific Academic platform asking people to participate in a survey about people's attitudes and beliefs. All items, informed consent, and debrief forms were uploaded to the survey platform, Qualtrics (Qualtrics, 2019). On the landing page, participants first read over the participant information sheet and provided their informed consent (Appendix B, Consent Form 5).

Consenting participants were then randomly divided into two conditions, video or written. Participants in the video condition watched an embedded video of the exact same module discussed in Chapter Four while participants in the written condition read the same transcript used in Chapter Four. As with Chapter Four, after either reading the transcript or watching the video, all participants indicated their behavioral intention both as a discrete and Likert variable and answered questions assessing presence and realism. Participants were then asked two open-ended, free-response questions assessing factors that drove them to the behavior they chose as well as deterred them from the other alternatives. Participants then

[75]As with Chapter Four, all inclusion and exclusion criteria was set using Prolific Academic's internal prescreening selection criteria.

answered standard demographic questions before being thanked and debriefed (Appendix A, Debrief 5 and Debrief 6). Upon completion, participants were paid £1.00. [76]

Scenario and Equipment

As with Chapter Four, participants in the written condition read a traditional vignette describing a situation (Appendix C, Set 13) and then were asked what they would do both as a discrete and Likert outcome variable. Due to the COVID-19 interruptions, in-person testing was not permitted by the university. As such, rather than using VR, the module was converted to a standard video. Using the VSDC Video Editor program the stimulus was edited to a binocular, 180° field of view embedded video. The video was uploaded and embedded into the Qualtrics survey using YouTube and displayed at a ratio of 1000x540. This ensured that the video was large enough to see and feel immersive without making the discrete behavioral options difficult to view. The video was coded to automatically play once the survey page loaded. Additionally, controls were removed so that participants could not pause, fast-forward, or rewind the playback. The video was the same video as described in the methodology of Chapter Four (Figure 6 and 7); however, the video did not have an embedded interactive element and participants chose their behavior using a multiple choice response on the same survey page. Thus, the concluding image was the selection pane as described in the methodology of Chapter Four (Figure 6).

Measures

Criminal Choice

As with Chapter Four, criminal choice was measured both using a single discrete item (Modal Response: "Just walk away", 54.60%) and three continuous Likert Variables on a 1 (Extremely Unlikely) to 7 scale (Extremely Likely; M_{walk} = 4.67, SD_{walk} = 2.13; M_{shove} = 4.39, SD_{shove} = 1.82; M_{hit} = 2.08, SD_{hit} = 1.53; Appendix C, Set 14). For participants in the written condition, the discrete options appeared in a random order at the end of the text describing the hypothetical scenario and the Likert-items followed on the next survey page. A similar process

[76]The funds for this research were derived from the remaining funds from Chapter Four that was disrupted as a result of COVID-19. Thank you to the Boak Fund at Clare Hall for funding this project.

was used for participants in the video condition, with an additional timing element. Specifically, to prevent priming or confusion, discrete options were not displayed until the page with the video had been loaded and displayed for 125 seconds. This time was chosen as this is the point in the embedded video when the selection pane (Chapter Four, Figure 6) appears.[77] Discrete options were also presented in a random order for participants in the video condition. Likert variables for participants in the video condition also were displayed on the following survey page (Appendix C, Set 14).

Presence and Realism

The same presence (α = 0.79; *M* = 32.79; *SD* = 6.60) and realism (α = 0.80; *M* = 31.96; *SD* = 5.81) items as in Chapter Four were used in this study as well (Appendix C, Set 15 and 16).

Open-ended Questions

Rather than using the traditionally researcher-generated, close-ended questions to assess what factors predict criminal intention, in this study two open-ended questions assessing deterrent and driving factors were used.[78] Specifically, participants were asked to freely write for two minutes about "the thoughts or factors that you believe ***lead to the behavior you chose***". Participants were then asked to do the same for factors that they believe "***discouraged you from choosing other potential behaviors***". Participants were also told, "these can be positive or negative factors, anything at all, but please try to be as specific as possible" (Appendix C, Set 19).[79]

[77]The discrete options were timed to the page timing and not the timing of the video itself. If the video needed to buffer or if participants may have paused the video (by clicking the video itself) the timing of the discrete options displayed and the selection pane appearing in the video may have become misaligned. However, considering the median time participants in the video condition spent on this was page approximately 137 seconds, and the discrete options appeared in 125 seconds, it is reasonable to conclude that this possibility was minimized and contamination through priming minimal.

[78]The greater literature refers to such factors as costs and benefits, respectively. However, doing so may misleadingly indicate an RCT perspective. As such, I chose to use the terms deterrents and drivers as they can encompass factors within an RCT perspective and other factors such as visceral emotions, dispositions, and heuristics.

[79]While similar research requested participants to provide a specific number of deterrents or drivers (e.g., Bouffard, 2002, 2007; Exum & Bouffard, 2010), doing so in this study would create a large range of survey completion times resulting in inconsistent payments for participants. To negate this and considering the limited financial resources, it was decided a two-minute time limit for each would be reasonable for payment purposes but also allow participants long enough to generate ideas.

All statements were coded using a hybrid approach of inductive and deductive coding (e.g., Fereday & Muir-Cochrane, 2006). First, all statements were coded against a pre-set framework derived from previous literature (i.e., Bouffard, 2002). In their work, Bouffard directly compared the use of closed-ended, researcher-generated questions to that of open-ended questions. In doing so, they found support for various theories and the use of traditional closed-ended, researcher-generated questions but also noted several parameters participants indicated that are not traditionally assessed. In total, seven deterrents and four drivers were identified (Table 16). These 11 categories were used as a framework by two researchers to independently code the data. As percent estimates can skew true inter-rater reliability, and each statement could have been one of multiple categories, inter-rater reliability was assessed using a weighted Cohen's Kappa ($\kappa = 0.60$; Cohen, 1960; McHugh, 2012).[80] Where there was a discrepancy, the reviewers conferred until an agreement could be made. All statements that were unable to be coded within the existing framework were then examined inductively for recurring themes by the two researchers.

[80]Thank you to fellow Cambridge Social Decision-making Lab member, Kayla Pincus, for being the second coder.

Table 16

Categories and their Descriptions used for Deductive Coding (Bouffard, 2002)

Category	Description
Deterrent	
Legal costs	Traditional deterrent cues that reference factors such as, getting arrested, the police or 'law' getting involved, going to jail or prison, etc.
Stigmatic	Negative factors that come as the result of other, non-legal parties (e.g., friends, family, romantic partners), becoming aware of your behavior. This can include aspects such as getting a bad reputation, humiliation, or loss of self-respect.
Attachment	Loss of relationships, either romantic, platonic, or familial, as a result of a behavior.
Commitment	Loss of future goals (e.g., I could not get into college) or present accomplishments (e.g., I could lose my job) as a result of a behavior.
Internal Future Emotions	Anticipating feeling guilt or shame as a result of a behavior.
Situational Costs	Costs specific to the behavior at hand. In the case of the 'bar fight' scenario presented here, this can be factors such as starting a fight, physical injury, damage to the bar, etc.
Morally Wrong	An internal moral code that deters a certain behavior. In this case examples may include, the belief that fighting is wrong or that violence never solves anything.
Drivers	
Situational Benefits	The overall utility derived from a certain behavior, does NOT include psychological benefit. Examples in the 'bar fight' scenario may include sending a message to the guy that he cannot hit on your girlfriend.
Enhanced Status	Increased social status, such as peer acceptance or impressing people, as a result of behavior.
Sneaky Thrills	A derived physiological pleasure or otherwise hedonistic outcome as a result of a behavior. Examples in the 'bar fight' scenario may include believing it would be exciting to be in a bar fight.
Internal Satisfaction	Increased pride or self-esteem as a result of a behavior.

Results

Criminal Choice by Condition

To assess if the medium a vignette was presented had a main effect of criminal choice and answer research question 1, a χ^2 test was used to analyze the discrete outcome variables and a one-way MANOVA was used to analyze the Likert outcome variable. As can be seen in Table 17, participants in the two conditions did not significantly differ regarding the discrete outcome variable of criminal choice ($\chi^2(2) = 1.18$, $p = 0.55$). Specifically, in both groups, approximately 55% of participants indicated that they would just walk away, approximately 40% indicated that they would shove the guy, and approximately 5% indicated they would hit the guy with a bottle.

Table 17

χ^2 Distribution of Discrete *Criminal Choice Outcome by Condition*

Condition	Just walk away (N, %)	Shove the guy (N, %)	Hit the guy with a bottle (N, %)	Total (N, %)
Video	100 (57%)	71 (40%)	6 (3%)	177 (100%)
Written	96 (53%)	76 (42%)	10 (5%)	182 (100%)
Total	196 (55%)	147 (41%)	16 (4%)	359 (100%)

Notes: $\chi^2(2) = 1.18$, $p = 0.55$

For the one-way MANOVA, the predictor variable was the condition a participant was in while the outcome variables were the three Likert items of 'just walk away', 'shove the guy', and 'hit the guy with a bottle'. Indicating a significant difference between conditions, the overall model was significant $F(3,355) = 0.98$, $p = 0.03$.[81,82] As a post-hoc comparison, three t-tests were used. As can be seen in Table 18, while there was no significant difference between conditions in regard to the likelihood of walking away ($p = 0.366$) or shoving the guy ($p = 0.707$), participants in the video condition were significantly less likely to hit the guy with a bottle compared to participants in the written condition ($M_{video} = 1.88$, $M_{written} = 2.27$; $M_{diff} = -0.39$, 95% CI [-0.71, -0.08], $Z = -2.82$, $d = -0.26$, 95% CI [-0.47, -0.05]), $p = 0.005$). In sum, while the discrete choice analysis (which has limited variability) did not reveal a significant

[81]The presented F-statistic is Wilks' Lambda, for full statistics please see Appendix D, Supplementary Table S33.
[82]It should be noted that while the data did not violate the homogeneity of the covariances matrices assumption ($\chi^2(6) = 4.06$, $p = 0.67$), the data violated the assumption of multivariate normality in both the video ($\chi^2(6) = 290.55$, $p < 0.001$) and written condition ($\chi^2(6) = 170.52$, $p < 0.001$).

difference between conditions, the MANOVA and resulting univariate analysis revealed that participants in the video condition were significantly less likely to hit the guy with the bottle.

Table 18

Group Comparisons of Likert Outcome Variables by Condition

Outcome Variable	Video *M* (*SD*)	Written *M* (*SD*)	Mean Difference (95% CI)	Statistic
Just walk away	4.81 (2.03)	4.54 (2.23)	0.27 (-0.17, 0.71)	$Z = 0.90$ $p = 0.37$
Shove the guy	4.44 (1.79)	4.35 (1.85)	0.09 (-0.30, 0.46)	$Z = 0.38$ $p = 0.71$
Hit the guy with a bottle	1.88 (1.44)	2.27 (1.60)	-0.39 (-0.71, -0.08)	$Z = -2.82$ $p = 0.005$

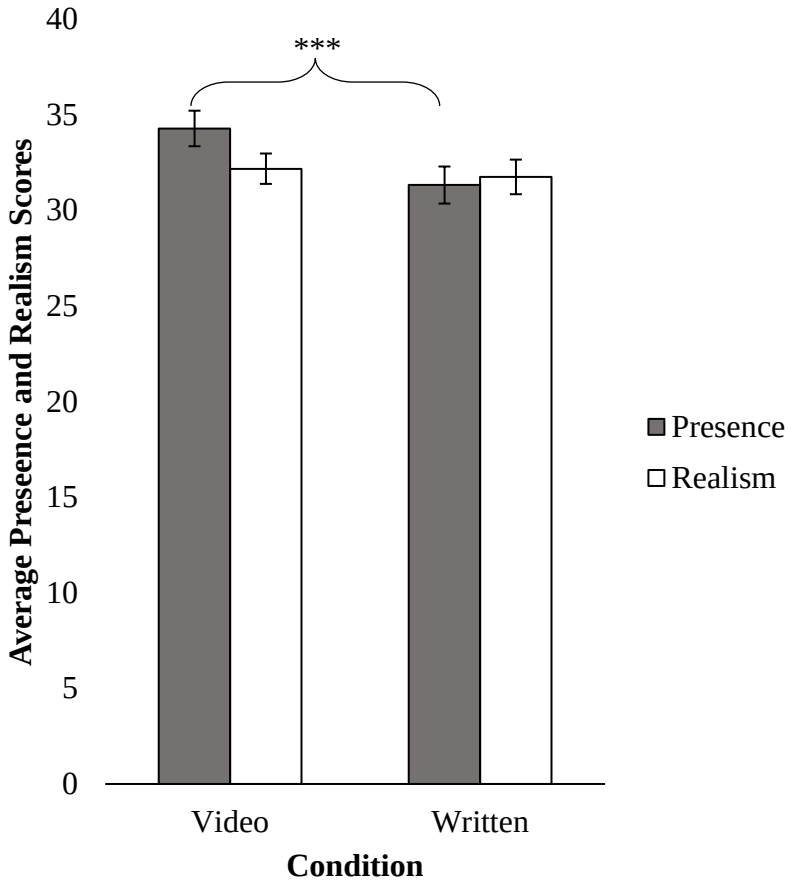
Notes: All outcome variables violated the assumption of multivariate normality, as such a Mann-Whitney test was conducted.

Presence and Realism by Condition

Two Mann-Whitney tests were conducted to answer research question 2 by assessing if the participants differed regarding their indicated subjective presence or perceived realism. Consistent with the results of Chapter Four, while there was no significant difference between participants in regard to realism ($M_{video} = 32.18$, $M_{written} = 31.75$, $M_{diff} = 0.43$, $p = 0.71$), participants in the video condition indicated significantly more presence than participants in the written condition ($M_{video} = 34.29$, $M_{written} = 31.33$, $M_{diff} = 2.96$, 95% CI [1.62, 4.30], $d = 0.46$, 95% CI [0.25, 0.67] $p < 0.001$; Figure 13).

Figure 14

Average Subjective Presence and Realism by Condition



Notes. Error bars represent exact 95% CIs. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

Open-ended Responses

Coding

In accordance with the growing qualitative literature highlighting the need for transparency and audit trails (e.g., Nowell et al., 2017; Sandelowski, 1995), in an effort to be as transparent as possible, in this section I first provide exclusion criteria as well as a coding example for the responses provided by participants to the open-ended questions.

In total, participants provided 1116 unique statements (M = 3, SD = 2). Responses that were not included were: 1) conceptual repeats, 2) incomplete thoughts or sentences, 3) conceptually or grammatically indecipherable responses, 4) cells left empty, or 5) indicated what one would do or speculation about what one would do 'if' something else would have

happened in the hypothetical scenario. For example, some participants indicated that they would always walk in this type of situation, unless the antagonist hit them first. If the antagonist hit them first, then they would have hit him back. This type of information tells us what a participant would have done in another scenario, but not why they chose the behavior they did in this scenario.[83]

As an example, and for coding transparency, please see Table 19. The participant has provided five unique statements and indicated that they would just walk away. Text in red is either unusable as it is an incomplete statement or indicates what one would do rather than describing why one did what they did. The blue text is conceptually repeating statement number three which indicates the participant did not want to get into longer conflicts. Statements two and three indicate clear costs that are specific to the context of the vignette (i.e., fights and longer conflicts). As such, they were coded as the existing category "Situational Costs" (Table 16; Bouffard, 2002).

Table 19

Example of Unique, Repeating, and Unusable Statements Provided by Participants

Driving Factors	Deterrent Factors
1) I think that I choose this option because I'm calm guy. 2) Also I don't want to get involved into some fights or into longer conflicts. I think that most people will pick this option because they are calm, solid,	3) I don't want to get involved in some longer conflict. 4) Also I don't like punching someone with glass bottle. It's inappropriate. 5) I don't want to became bad man in Lisa eyes.

Notes: Text in red is either unusable as it is an incomplete statement or indicates what one would do rather than describing why one did what they did. The blue text is conceptually repeating statement number three which indicates the participant did not want to get into longer conflicts. Text in black was able to be categorized.

As the participant indicates the action of hitting someone with a bottle is inappropriate, but does not indicate a specific cost (e.g., inappropriate because he could get hurt), statement number four aligns with and was coded as the existing framework category "Morally Wrong" (Table 16; Bouffard, 2002). Statement number five aligns with and was coded as the existing framework category "Stigmatic" (Table 16; Bouffard, 2002). Specifically, the participant

[83]Some may argue that this information could be reversed and applied to the context at hand. For example, one could take the statement "I would hit him if he hit me first" to mean "I didn't hit him because he didn't hit me first". However, and as argued further in the discussion of this chapter and general discussion of the thesis (Chapter Six), to do so would lead to a greater chance of misspecification of a participant's response.

indicates that they do not want to be viewed badly in their girlfriend's eyes. While one could argue this is an attachment cost (i.e., loss of the girlfriend), since the participant did not explicitly indicate a loss of the relationship but only being viewed badly, it was decided that this item better fit within the "Stigmatic" category. Finally, in statement number one the participant indicates their calm disposition is what lead them to choose to walk away. Dispositional differences are not included in the original framework. Thus, this led to the creation of a new category (Deterring Dispositions, further discussed below).

Existing Framework vs. New Categories

Of the 1116 unique statements 348 (31%) fit within the existing categories defined by Bouffard (2002), while 768 (69%) did not (research question 3). Of the 348 unique statements that fit within the existing categories: 53 were Legal Costs; 30 were Stigmatic; 8 were Attachment Costs; 1 was a Commitment Cost; 1 was Internal Future Emotions; 168 were Situational Costs; 52 were Morally Wrong; 29 were Situational Benefits; 5 were Enhanced Status; 0 were Sneaky Thrills; and 1 was Internal Satisfaction (See Table 16 above for a description of each category.

To answer research question 4, two researchers assessed the remaining statements that did not fit an existing category for potential new categories. In total, 20 new categories were created, of which seven were deemed deterrents, six were deemed drivers, and seven indicated methodological aspects. Of the 768 remaining statements, 614 (80%) were able to be categorized within these new categories.[84] This resulted in a total of 962 statements for analysis.

New Deterrents

Of the new seven deterrent categories, some of the mentioned deterrents were the opposite of the those presented in the study by Bouffard (2002). Specifically, some deterrents

[84]In total, 154 statements (14% of the 1116 total statements) were unable to be categorized. One of the main reasons for being unable to categorize a statement was due to a lack of context to ensure a statement was not placed as a driver when it was a deterrent or vice versa. For example, several participants indicated one-word answers such as, "Self-esteem". However, it is not possible to determine if this means to preserve self-esteem and avoid a stigma (Stigmatic Cost) or because they have high self-esteem and do not see the point in fighting (Absence of a benefit).

were actually *benefits* of adhering to law-abiding behavior (compared to the benefits of crime). For example, participants noted the benefits of not committing a crime such as, "no one gets hurt" (Deterring Benefit, Table 20). Similarly, participants also indicated that there was no cost to just walking away while highlighting there was no benefit to committing a crime. Such statements were categorized as "The absence of a benefit/No cost" (Table 20). While seemingly similar to being deterred by costs, what was unique was no mention of costs, just that there were simply no benefits to the crime.

Participants also indicated that their dispositions deterred them from a criminal alternative (Deterring Dispositions, Table 20). Other participants noted that an unspecified negative outcome would occur if they chose a criminal behavior (e.g., "I would get in trouble", Unspecified Negative Outcomes, Table 20). Being unspecified made it impossible to categorize in the existing framework.[85] The behavior of the antagonist within the vignette was also noted as a deterrent (Deterring Behavior of the Antagonist, Table 20). For example, some participants indicated the man was too aggressive, looked strong, or otherwise looking for trouble, and that deterred them from engaging with him. Other participants indicated that they trusted their partner and that deterred them from engaging with the antagonist (I Trust my Partner, Table 20). Finally, participants also indicated a heuristic approach noting walking away was either the only option, the best, or right thing to do (The Right/Best/Only thing To Do; Table 20).

[85]While one may argue that unspecified negative outcomes could be categorized as "Situational Costs" (Bouffard, 2002) this would be an error. Situational costs are specific to the crime being analyzed and therefore would differ between scenarios, while every scenario could have unspecified negative outcomes (e.g., 'getting in trouble').

Table 20

Category Descriptions used for the Inductive Coding of Deterrents

Category (N)[a]	Description
Deterring Benefit *N* = 19	A benefit derived from *not* exhibiting a criminal behavior. *"Walking away would in this case not only make him look like a fool but would also keep the situation under control without anyone getting hurt or injured."*
Deterring Disposition *N* = 98	Dispositional factors that deter individuals from engaging in a crime. *"I am mostly a calm and not violent person"*
Absence of a Benefit/No Cost *N* = 29	The recognition that there is no benefit to committing a crime and/or no cost to not committing a crime. *"It [walking away] would not lead to any problems for me"* *"I chose to walk away because I felt the other options would not be beneficial in any way"*
The Right/Best/Only Thing to Do *N* = 27	Indicating that the walking away was simply the best, right, or only option. *"Avoiding conflict seems to be the best approach"* *"It is better to walk away"*
Deterring Behavior of the Antagonist *N* = 17	Specific mention of the behavior or attitude of the antagonist that deterred the individual from engaging with a crime. *"The man was really aggressive from the beginning and had a big arm"*
Unspecified Negative Outcomes *N* = 36	Negative outcome that are general or specific that did not fit within the categories defined by Bouffard (2002). *"It would lead to a lot of problems"* *"Ultimately, engaging in the confrontation would be damaging in some way"*
I Trust my Partner *N* = 19	Indicating the participant would not engage in criminal behavior because they trust their partner and/or are secure in their relationship. *"I'm the one with Lisa, I don't have nothing to worry about on what our relationship status concern"* *"I have trust in my partner that even if he was hitting on her she would politely turn him down"*
N_{total} = 245	

Notes: [a] indicates the number of individual statements out of the 614 that did not fit within the existing framework that were categorized in the new framework. The italicized text are excerpts from response provided by participants.

New Drivers

In regard to new drivers, the new category "Driving Stigmatic" was created to encompass statements such as "walking away would make me look weak" or "only a coward would let another man talk to their girlfriend that way" (Table 21). In this instance, something that drove a participant to indicate a criminal behavior was the potential of a negative stigma

for not committing a crime with no mention of enhanced status (e.g., It would make me look cool or strong). Similarly, participants noted other situational costs that could occur if they did not commit the crime, such as the man potentially assaulting Lisa. As such, the category "Driving Situational Costs" was created (Table 21). As many participants indicated that their anger, annoyance, frustration, or jealousy lead them to their behavior, "Affect", was a category that was created as a driver (Table 21). As with deterrents, several participants indicated their disposition and the behavior of the antagonist was the main reason for their decision. As such, two categories, "Driving Dispositions" and "Driving Behavior of the Antagonist" were created (Table 21). Finally, participants noted the need, responsibility, or duty to either protect their girlfriend and/or punish the antagonist for their behavior as a driving factor. The category, "Retribution and Responsibility" was created to capture these elements (Table 21).

Table 21

Category Descriptions used for the Inductive Coding of Drivers

Category (N)[a]	**Description**
Driving Stigmatic *N* = 38	The indication that a participant could not choose the law abiding option because of the negative stigma associated with it. *"I didn't want to go away and show that I was weak"*
Driving Situational Cost *N* = 33	A general cost associated with choosing the law abiding option. *"The man could have harmed my girlfriend if I just walked away"*
Driving Dispositions *N* = 20	Dispositional factors that drive participants to selecting a criminal option. *"Walking away is not my usual behavior"* *"I'm just a type of a little aggressive person"*
Retribution and Responsibility *N* = 37	Driving factors that indicate the participants have a responsibility to protect their girlfriend and/or must punish or teach the antagonist a lesson. *"Certainly I wouldn't just avoid him because I had to defend my girlfriend"* *"This type of people need to learn their lessons the hard way"*
Affect *N* = 49	Indication that a participant chose a criminal option because they felt angry, jealous, annoyed, or other approach negative emotions. *"This guy really pissed me off"* *"I would be really angry in this situation"*
Driving Behavior of the Antagonist *N* = 81	Specific mention of the behavior or attitude of the antagonist that drove the individual to engaging with a crime. *"First of all, the guy's attitude was very rude and inappropriate and also disrespectful towards me. Secondly, he was provoking me and was talking an offensive stance to fight me most likely, so my option would be to hit him or shove him."*
N_{total} = 258	

Notes: [a] indicates the number of individual statements out of the 614 that did not fit within the existing framework that were categorized in the new framework. The italicized text are excerpts from response provided by participants.

Methodological Statements

Finally, participants provided several statements that highlighted methodology. Most notably, participants often indicated that they needed more information to really decide what they would do (I Need More Information, Table 22). Participants also commented directly on the vignette presentation indicating it influenced their decision-making (Clear Indication of Methodology, Table 22). Participants also indicated that they would have behaved differently from the protagonist at the beginning (The Situation is not How I would Have Acted to Begin With, Table 22) or that they explicitly tried to pick they behavior that they thought they would exhibit in real-life (I Chose to Behave How I would in Real Life, Table 22). Participants stated that the partner in the vignette should have behaved differently (Lisa Should Have Done More, Table 22). Participants evaluated the option of hitting the man with a bottle as too aggressive or over the top, but did not associate it with a specific cost such as injury or death (Hitting a man with a Bottle is too Aggressive, Table 22). Finally, participants also indicated their behavior was driven by the fact that one option was seemed to be most balanced or the middle ground (Cognitive Trade off/Balancing Act, Table 22). These final two categories were placed within the methodology category as they are potentially an artefact of the study design (further discussed below).

Table 22

Category Descriptions used for the Inductive Coding of Drivers

Category (N)[a]	Description
"I Need More Information" *N* = 15	Participants indicating that they wish they had more information or needed more information to make a better decision. "*It strikes me as strange to not be presented with Lisa's reaction at all. What did she do while all that was happening?"*
Lisa Should Have Done More *N* = 27	Participants indicating that they thought Lisa should have done more within the situation. *"Lisa did little to contribute, she remained in her chair"*
Clear Indication of Methodology *N* = 4	Participants indicating that the way the information was presented influenced their decision-making. *"I felt that the interaction was leading me to behave in a more aggressive manner as the interaction was scripted leading to the confrontation"* "*Even watching through the screen, that aggression really built on to me in such a personal way that I felt as though that was really my girlfriend and that I was really being cheated"*
The Situation is not How I would Have Acted to Begin With *N* = 13	Participants indicating that they would have handled the situation differently than the protagonist from the start. *"I would have tried to act a bit different to the guy than the way it was presented in the video"*
I Chose to Behave How I would in Real Life *N* = 3	Participants explicitly mentioning that they chose what they thought they would do in real life. *"I had to put myself in the shoes of the character and thinking about my personal life and whenever I am confronted was where leads to the behavior I chose. Simply because it was the closest to what I would do in real life."*
Cognitive Trade off/Balancing Act *N* = 21	Participants indicating that they balanced outcomes before choosing their behavior. *"The option was most balanced"*
Hitting a man with a Bottle is too Aggressive *N* = 28 N_{total} = 111	Evaluation of the option of hitting the man with the bottle as too aggressive or dangerous without specifying a cost alongside it. *"Hitting the guy with a bottle would be an overreaction"* *"Hitting him with a bottle would be extreme and exaggerated"*

Notes: [a] indicates the number of individual statements out of the 614 that did not fit within the existing framework that were categorized in the new framework. The italicized text are excerpts from response provided by participants.

Conceptual Validity of Open-ended Responses

As a first step, I sought to establish a preliminary level of validity of the categorization of responses given by participants using a simple correlation matrix and a series of binomial logistic regressions. All factors were first combined into their relative deterrent and driving

valence to create four variables: 1) existing deterrents (Table 20), 2) existing drivers (Table 20), 3) new deterrents (Table 21), and 4) new drivers (Table 22). In this context, the label "existing" refers to the original categories derived from Bouffard (2002) and new refers to categories developed within this study.

As anticipated, new deterrents were significantly positively related to walking away ($r = 0.42$, $p < 0.001$) and significantly negatively related to shoving the guy and hitting the guy with a bottle ($r_{shove} = -0.31$, r_{hit} -0.23, both $p < 0.001$; Table 23). While existing deterrents were significantly positively related to walking away ($r = 0.23$, $p < 0.001$) and significantly negatively related to hitting the guy with a bottle ($r = -0.19$, $p < 0.001$), it was not significantly associated with shoving the guy ($r = -0.10$, $p = 0.06$). Both existing and new drivers were significantly negatively related to just walking away ($r_{\text{existing}} = -0.27$, $r_{\text{new}} = -0.53$, both $p < 0.001$), significantly positively related to shoving the guy ($r_{\text{existing}} = 0.20$, $r_{\text{new}} = 0.46$, both $p < 0.001$), and significantly positively related to hitting the guy with bottle ($r_{\text{existing}} = 0.16$, $p = 0.002$; $r_{\text{new}} = 0.28$, $p < 0.001$).

Furthermore, as an illustration of conceptual consistency, existing drivers were significantly positively related to new drivers ($r = 0.21$, $p < 0.001$) but significantly negatively related to new deterrents ($r = -0.13$, $p = 0.014$). Moreover, new deterrents and new drivers were significantly negatively correlated ($r = -0.33$, $p < 0.001$). That is, factors that would drive participants to a criminal behavior were negatively related to factors that would deter them from criminal behavior. However, there was no negative correlation between existing deterrents and existing drivers as one would anticipate ($r = -0.00$, $p = 0.95$), nor did existing deterrents significantly relate to new deterrents nor new drivers ($r_{newdeter} = 0.10$, $p = 0.06$; $r_{newdrive} = -0.05$, $p = 0.35$). To summarize, all predictors relate to the outcome variable in the expected relationship, but existing deterrents do not relate to other variables in the anticipated direction. Moreover, the correlations were not strong enough to suggest a redundancy between concepts.

Table 23

Correlation Matrix of Behavior Outcomes and Existing as well as New Categories

	Walk Away	Shove the guy	Hit the guy with a bottle	Existing Deterrents	Existing Drivers	New Deterrents	New Drivers
Walk Away	-						
Shove the guy	-0.40***	-					
Hit the guy with a bottle	-0.56***	0.34***	-				
Existing Deterrents	0.23***	-0.10	-0.19***	-			
Existing Drivers	-0.27***	0.20***	0.16*	-0.00	-		
New Deterrents	0.42***	-0.31***	-0.23***	0.10	-0.13**	-	
New Drivers	-0.53***	0.46***	0.28***	-0.05	0.21***	-0.33***	-

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$

As a further validity check and first answer to research question 5, each grouping of variables were used as predictors in a binomial logistic regression in which the outcome variable was the discrete criminal behavior variable. For consistency, as with Chapter Four, the discrete variable was recoded so that both shoving the guy and hitting him with a bottle were scored as a 1 while walking away was a 0. Additionally, to aid in interpretation, all predictor variables were first standardized. Three models were analyzed successively. Model 1 included existing deterrents and drivers, Model 2 included new deterrents and drivers, and Model 3 was a combined model (Table 24). First, in Model 1 (Table 24) both existing drivers and deterrents are significant. Specifically, for every one standard deviation increase in existing deterrents, the odds of committing a crime decrease by a factor of 0.58 (95% CI [0.44, 0.76]) while for every one standard deviation increase in existing drivers the odds of committing a crime increase by a factor of 3.93 (95% CI [1.87, 8.23]), The model itself is significant (χ^2 (2) = 58.3, $p < 0.001$) and demonstrates moderate predictive ability (AUC = 0.69).

In Model 2 (Table 24) both new drivers and deterrents are significant. For every one standard deviation increase in new drivers, the odds of committing a crime increase by a factor of 6.54 (95% CI [3.91, 10.93]), while for every one standard deviation increase in new deterrents, the odds of committing a crime decrease by a factor of 0.21 (95% CI [0.12, 0.34]). The model itself is significant (χ^2(2) = 217.00, R^2 = 0.44) demonstrating excellent predictive ability (AUC = 0.90). A model combining new and existing deterrents and drivers outperforms Model 1 ($\Delta\chi^2$ (2) = 191.00, $p < 0.001$) as well as Model 2 ($\Delta\chi^2$ (2) = 32.50, $p < 0.001$; Table 24). Moreover, while changing in magnitude slightly, all predictors remain significant in the same direction.

In sum, taking the correlation matrix and regressions collectively, both existing as well as new deterrents and drivers significantly associate with criminal behavior in the anticipated directions. Additionally, the variables appear to be non-redundant, suggesting they indeed tap into different constructs. Finally, considering the magnitude of the correlations, magnitude and narrow confidence intervals of the Odds Ratios, as well as the R^2 and AUC statistic, it appears that the new deterrents and drivers are better predictors of criminal behavior.

Table 24

Binomial Logistic Regression of Criminal Behavior on Existing and New Deterrents and Drivers

Predictor	Model 1- Existing OR (95% CI)	Model 2 - New OR (95% CI)	Model 3 - Combined OR (95% CI)
Existing Deterrents	0.58 (0.44, 0.76)***	-	0.48 (0.33, 0.71)***
Existing Driver	3.93 (1.87, 8.23)***	-	3.54 (1.49, 8.43)**
New Deterrents	-	0.21 (0.12, 0.34)***	0.19 (0.11, 0.34)***
New Driver	-	6.54 (3.91, 10.93)***	6.40 (3.70, 11.06)***
Intercept	0.96 (0.72, 1.28)	0.80 (0.55, 1.16)	0.84 (0.54, 1.29)
Deviance	436	278	246
AIC	442	284	256
χ^2 (df), *p*	(2) = 58.3 ***	(2) = 217 ***	(4) = 249 ***
VIF (Range)	1.01	1.00	1.02 – 1.08
McFadden's R^2	0.12	0.44	0.50
Specificity	61.20%	92.30%	84.20%
Sensitivity	67.50%	65.60%	85.90%
AUC	0.69	0.90	0.93

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$

RCT Predictors vs. Other Predictors

To determine if the factors provided did or did not fall within a traditional RCT framework (research question 6), all categories (existing and new) were combined into one of four categories: 1) RCT Deterrents, 2) RCT Drivers, 3) Other Deterrents, or 4) Other Drivers. Categories within the RCT Deterrents included: Legal Deterrents; Stigmatic Deterrents; Attachment Costs; Commitment Deterrents; Internal Future Emotions; Situational Costs; Deterring Benefits; Unspecified Negative Outcomes; and Absence of a Benefit/No Cost. Categories within the RCT Drivers included: Situational Benefits; Enhanced Status; Sneaky Thrills; Internal Satisfactions; Driving Stigmatic; Driving Costs; and Cognitive Trade off/Balancing.

Categories in the Other Deterrents included: Morally Wrong; The Right/Best/Only thing to do; Deterring Behavior of the Antagonist; I Trust my Partner; and Deterring Dispositions. Categories in the Other Drivers included: Affect; Driving Behavior of the Antagonist; Retribution and Responsibility; and Driving Dispositions. Of the 962 statements that were able to be categorized, 472 (49%) fit within a traditional RCT framework and 400 (42%) did not. The remaining were methodological factors.

As with the existing and new categories, I first used a correlation matrix to assess the relationship between the categories within the RCT framework, those categorized as Other, and criminal behavior. As can be seen in Table 25, all deterrents and drivers held significant associations with walking away in the anticipated direction with deterrents being positively associated and drivers being negatively associated. RCT Drivers and Other Drivers were positively related to both shoving the guy (r_{RCT} = 0.32, $p < 0.001$; r_{other} 0.39, $p < 0.001$) and hitting the guy with a bottle (r_{RCT} = 0.14, $p < 0.001$; r_{other} 0.24, $p < 0.001$). Conversely, Other Deterrents were significantly negatively associated with shoving the guy (r = -0.26, $p < 0.001$) and hitting the guy with the bottle (r = -0.14, $p < 0.01$). Similarly to the existing and new categorization discussed above, RCT deterrents were significantly negatively associated with hitting the guy with a bottle (r = -0.19, $p < 0.001$), but held no relationship with shoving the guy (r = -0.08, p = 0.14), nor with the other predictors. Finally, while there was a positive association between RCT Drivers and Other Drives as anticipated, the correlation was small in magnitude suggesting a set of non-redundant features.

Table 25

Correlation Matrix of Behavior Outcomes and Existing as well as New Categories

	Walk Away	Shove the guy	Hit the guy with a bottle	RCT Deterrents	RCT Drivers	Other Deterrents	Other Drivers
Walk Away	-						
Shove the guy	-0.56***	-					
Hit the guy with a bottle	-0.40***	0.34***	-				
RCT Deterrents	0.22***	-0.08	-0.19***	-			
RCT Drivers	-0.43***	0.32***	0.15**	0.05	-		
Other Deterrents	0.33***	-0.26***	-0.14**	0.03	-0.21***	-	
Other Drivers	-0.39***	0.37***	0.24***	-0.05	0.17**	-0.22***	-

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$

Next, using a logistic regression, a binary criminal behavior outcome variable (0 = walk away) was regressed onto three models. To aid in interpretation, all predictors were first standardized. Model 1 included the RCT Deterrents and Drivers, Model 2 included the Other Deterrents and Drivers, and Model 3 is a combined model (Table 26). In Model 1, for every one standard deviation increase in RCT Deterrents the odds of indicating shoving or hitting the guy with a bottle decrease by a factor of 0.57 (95% CI [0.33, 0.66]), while for every one standard deviation increase in RCT Drivers the odds of indicating shoving or hitting the guy with a bottle increase by a factor of 9.27 (95% CI [4.93, 17.1]). The model itself is significant ($\chi^2(2) = 135.00$, $p < 0.001$) and demonstrates good predictive accuracy (AUC = 0.81).

In Model 2, other deterrents and drivers were both significant. Specifically, for every one standard deviation increase in other deterrents the odds of indicating shoving or hitting the guy with a bottle decreased by a factor of 0.40 (95% CI [0.29, 0.55]), while for every one standard deviation increase the odds of indicating shoving or hitting the guy with a bottle increased by a factor of 3.65 (95% CI [1.40, 5.56]). Overall, the model is significant ($\chi^2(2) = 129.00$, $p < 0.001$) with good predictive accuracy (AUC = 0.81).

A combined model outperformed both individual models (Model 1: $\Delta\chi^2(2) = 94.10$, $p < 0.001$; Model 2: $\Delta\chi^2(2) = 100.00$, $p < 0.001$). All predictors remained significant and in the expected direction with minor changes in magnitude. Notably, the McFadden's R^2 doubled from approximately 0.26 in either model to 0.46, and the AUC statistic increased to an excellent statistic of 0.91. In sum, of the 962 statements approximately 50% fell within a traditional RCT framework with RCT Drivers having the greatest effect. Importantly, when controlling for one another, all factors remained significant predictors in the anticipated direction and a combined model outperformed either individual model (e.g., RCT Drivers and Deterrents).

Table 26

Binomial Logistic Regression of Criminal Behavior on RCT and Other Deterrents and Drivers

Predictor	Model 1- RCT OR (95% CI)	Model 2 - Other OR (95% CI)	Model 3 - Combined OR (95% CI)
RCT Deterrents	0.57 (0.33, 0.66)***	-	0.41 (0.27, 0.61)***
RCT Drivers	9.27 (4.93, 17.41)***	-	8.45 (4.28, 16.66)***
Other Deterrents	-	0.40 (0.29, 0.55)***	0.42 (0.29, 0.63)***
Other Drivers	-	3.65 (2.40, 5.56)***	3.87 (2.40, 6.24)***
Intercept	1.14 (0.82, 1.59)	0.88 (0.66, 1.17)	1.15 (0.78, 1.70)
Deviance	359	366	265
AIC	365	372	275
χ^2 (df), *p*	(2) = 135 ***	(2) = 129 ***	(4) = 229 ***
VIF (Range)	1.08	1.00	1.02 – 1.17
McFadden's R^2	0.27	0.26	0.46
Specificity	98.40%	94.40%	93.40%
Sensitivity	45.40%	49.70%	69.90%
AUC	0.81	0.81	0.91

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$

To summarize, the categories derived from the responses of participants behave with the likelihood of walking away and shoving or hitting the guy with a bottle in the correct theoretical direction. Specifically, deterrents are consistently positively related to walking away but negatively related to shoving the guy or hitting the guy with a bottle. Conversely, drivers are consistently negatively related to walking away but positively related to shoving the guy or hitting him with a bottle. When comparing existing categories to the categories developed in this study, it appears that new drivers are the strongest predictors. Nonetheless, both existing and new deterrents and drivers are significant predictors of aggressing when controlling for the effects of one another and outperform either singular model. A similar pattern was observed when examining the responses as factors that either did or did not fit within the RCT framework. Specifically, RCT drivers appear to be the strongest predictor. Nonetheless, and more importantly to the theme of this thesis, factors that do and do not fit within the RCT framework significantly predict aggressive behavior when controlling for one another, and the combined model outperforms either singular model in regards to predictive accuracy and variance explained.

Differences in Categories by Condition

As indicated in the literature review above, it is important for researchers to know if the predictors of criminal decision-making differ based on how the vignette was presented. Specifically, it is methodologically critical to understand if participants that experience a vignette in VR consider a set of factors that 1) differ from the set of parameters researches traditionally assess and/or 2) differ from the set of factors considered by participants that read a vignette as written text. Above I have answered question one by demonstrating that participants consider several factors not traditionally assessed, and these factors may be better predictors of criminal behavior. By knowing if factors differ based on how a vignette is presented, researchers may modify their assessments to better align with the factors participants consider naturally (both in VR and when reading text). This in turn will increase the certainty of any resulting theory in predicting real-world criminal decision-making. In doing so researchers can model more components of decision-making than just the original deterrent cues (e.g., severity and likelihood of punishment). To meet this aim, in this section I seek to answer question 2 by comparing the factors considered by participants based on if they experienced the vignette as video or read it.

Existing vs. New Categories. To assess if participants indicated different amounts of factors that did or did not fit within the existing framework (Bouffard, 2002) based on how the vignette was presented, I examined the descriptive statistics of each broadly (research question 7). First, all categories were coded to be dichotomous with a score of zero indicating a participant did not mention a factor that fit within that category and a score of one indicating the participant indicated at least one factor that within that category. As can be seen in Table 27, more participants in both conditions indicated factors that did not fit within the existing categories. Specifically, only 99 participants in the video condition and 103 participants in the written condition indicated at least one factor that fit within the existing categories. Conversely, 141 participants in the video condition and 149 in the written condition indicated at least one factor that fit within the new categories. However, there was no difference between the video and written condition regarding the number of participants that listed at least one factor in the new, existing, or methodological categories.

Table 27

Distribution of Factors by Existing and New Categories by Condition

	Video ***N, M (SD)***	**Written** ***N, M (SD)***	χ^2
New Categories	141 (80%)	149 (82%)	(1) = 0.02, p = 0.90
Existing Categories	99 (56%)	103 (57%)	(1) = 0.28, p = 0.60
Methods	48 (27%)	41 (23%)	(1) = 1.02, p = 0.31

Notes: The percentage displayed is the percentage of participants that indicated a minimum of one factor that fit within the respective category

A Wilcoxon signed-rank test was used to assess for within group differences between new categories, existing categories, and methods. As one would anticipate, participants in both the video and written condition indicated significantly more factors that fit within the new categories compared to the existing categories (Z_{video} = 5.89, $Z_{written}$ = 4.98, p < 0.001) and compared to the methodological category (Z_{video} = 10.97, $Z_{written}$ = 11.24, p < 0.001). Additionally, participants in both conditions indicated significantly more existing factors than methodological factors (Z_{video} = 5.96, $Z_{written}$ = 6.10, p < 0.001). Taken collectively, participants indicated more factors that did not fit within the existing categories than did. However, there was no difference in the amount of existing, new, or methodological factors between participants. That is, participants in the video and written conditions indicated similar amounts of new, existing, and methodological factors.[86]

Next, I sought to examine if being in the video or written condition modified the relationship between existing as well as new deterrents and drivers and criminal behavior. To achieve this, the binomial regression presented earlier (i.e., Table 24) was reanalyzed with an interaction term (ConditionXPredictor). As a first step, the condition a participant was in was put in the first predictor (Model 1), followed by the existing and new categories (Model 2), and finally an interaction of the two main effects was entered (Model 3). For brevity, only the model including interaction effects is discussed here, for full results please see Appendix D, Supplementary Table S34. Although a model with an interaction was significant ($\chi^2(9)$ = 252.73, p < 0.001), it did not outperform a model with only main effects ($\chi^2(4)$ = 3.38, p = 0.497). Specifically, none of the interaction terms were significant. Additionally, there was a

[86]Using the average number of responses a participant provided in each category, an additional Mann-Whitney test supports this finding (Appendix D, Supplementary Table S35).

high term of multicollinearity between condition, existing drivers, and the interaction of the two. Removing the interaction between condition and existing drivers resolves the multicollinearity issues, but the model parameters remain the same with none of the interactions being significant.[87] As such, it does not appear that how a vignette is presented modifies the relationship between existing nor new predictors and criminal behavior.

RCT vs. Other Categories. Next, I assessed if conditions differed in regard to the number of factors indicated that did or did not fit within the RCT framework (research question 7). First, both categories (RCT and Other) were recoded to be dichotomous with zero indicating a participant did not indicate a factor that fit within that category and one indicating that a participant indicated at least one factor that fit within that category. As can be seen in Table 29, in both conditions, approximately 60% of participants indicated at least one factor that fit within the RCT framework and approximately 65% participants indicated at least one factor that did not fit within the RCT framework. A χ^2 analysis indicated that there was no difference between conditions in regard to the number of factors provided that did or did not fit within the RCT framework (Table 29).[88] A Wilcoxon signed-rank test was used to assess for within-group differences between the number of factors that did and did not fit within the RCT framework. As one would anticipate, neither participants in the video condition ($Z = 0.84$, $p = 0.40$) nor in the written condition ($Z = 1.32$, $p = 0.19$) differed in regard to the amount of factors that did or did not fit within the RCT framework.

Table 28

Distribution of Factors by RCT and Other by Condition

	Video ***N, M* (*SD*)**	**Written** ***N, M* (*SD*)**	χ^2
RCT	110 (62%)	115 (63%)	(1) = 0.04, $p = 0.84$
Other	115 (65%)	122 (67%)	(1) = 0.17, $p = 0.68$

Notes: The percentage displayed is the percentage of participants that indicated a minimum of one factor that fit within the respective category

Finally, I sought to examine if being in the video or written condition modified the relationship between criminal behavior and factors that did and did not fit within the RCT

[87]A model removing the main effect of existing deterrents and leaving the interaction returned very similar estimates.

[88]Using the average number of response provided in each category, A Mann-Whitney test supports this conclusion for factors that fit within the RCT framework ($Z = -0.18$, $p = 0.86$) and factors that do not ($Z = 0.27$, $p = 0.79$).

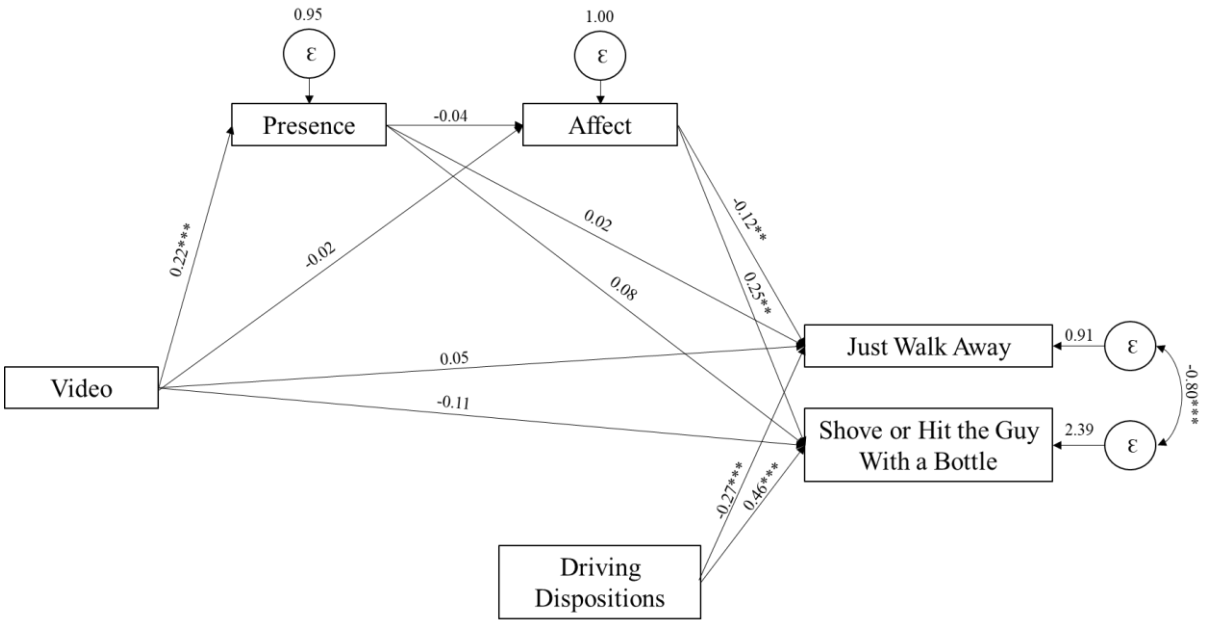
framework. As with the analysis on existing and new deterrents and drivers, to achieve this, the binomial regression presented earlier (i.e., Table 26) was reanalyzed with an interaction term (ConditionXPredictor). As with the analyses above, as a first step the condition a participant was in was put in the first predictor (Model 1), followed by the existing and new categories (Model 2), and finally an interaction of the two main effects was entered (Model 3). For brevity only the interaction model is discussed in text, for full results please see Appendix D, Supplementary Table S36. As with the model using existing as well as new deterrents and drivers, although the model with the interaction terms was significant ($\chi^2(9) = 224.54$, $p < 0.001$), it did not outperform a model with only main effects ($\chi^2(4) = 4.49$, $p = 0.497$). Specifically, none of the interaction terms were significant. As such, how a vignette is presented does not appear to modify the relationship between criminal decision-making and factors that do and do not fit within the RCT framework.

Serial Mediation of VR on Criminal Decision-making

As a final analysis I sought to complement the serial mediation analysis presented in Chapter Four by using a larger sample size and a simple path analysis. As with the model presented in Chapter Four, the condition a participant was in was coded as (0 = Written; 1 = Video). Two dependent variables were used. The first was the Likert item assessing the likelihood of walking away. For the second dependent variable, the two Likert items assessing the likelihood of shoving and hitting the guy with a bottle were combined into a single item. Although the same presence variables used in Chapter Four were used in this chapter, the variables for state anger and trait aggressiveness were not included. However, the free-response categories of "Affect" and "Driving Disposition" may be used as reasonable proxies. Specifically, the "Affect" category encompassed affective components such as anger, frustration, and annoyance as driving factors for shoving or hitting the guy with a bottle. Additionally, the "Driving Dispositions" category centralized on dispositional factors such as aggression and being a "fighter" that drove a participant to either shove or hit the guy with the bottle. As such, these free response categories were input as the mediators and control variables in the model (Figure 15).

Figure 15

Serial Mediation of Virtual Reality on Intention to Aggress



Notes. The presented coefficients are standardized. The variable Video is dummy coded (0 = written; 1 = VR). The free-response categories of "Affect" and "Driving Disposition" were used as reasonable proxies for the variables Anger and Trait Aggressiveness, respectively. Model Fit: $\chi^2(2) = 1.31$, $p = 0.521$, RMSEA = 0.00 95% CI [0.00, 0.09], CFI = 1.00, TLI = 1.02, SRMR = 0.01.

Overall, the model demonstrated excellent fit ($\chi^2(2) = 1.31$, $p = 0.521$, RMSEA = 0.00 95% CI [0.00, 0.09], CFI = 1.00, TLI = 1.02, SRMR = 0.01; Figure 15). However, caution should be taken when interpreting this fit as the model is almost saturated with only 2 degrees of freedom. Similar to model presented in Chapter Four, affect (the proxy for state anger) was significantly negatively related to likelihood of walking away (β = -0.12, 95% CI [-0.22, -0.03], $p = 0.014$) and positively related to the likelihood of shoving or hitting the guy with a bottle (β = 0.25, 95% CI [0.09, 0.41], $p = 0.002$). Additionally, driving dispositions (the proxy for trait aggressiveness) was significantly negatively related to the likelihood of walking away (β = -0.27, 95% CI [-0.37, -0.17], $p < 0.001$) and significantly positively related to the likelihood of shoving or hitting the guy with a bottle (β = 0.46, 95% CI [0.30, 0.62], $p < 0.001$). Finally, being in the video condition was significantly positively related to subjective presence (β = 0.22, 95% CI [0.12, 0.33], $p < 0.001$; Figure 15).

However, unlike the model presented in Chapter Four, neither condition ($p = 0.736$) nor presence was significantly related to affect ($p = 0.501$). Additionally, there were no indirect

effects present. Specifically, there was no indirect effect of being in the video condition on affect (p = 0.506). Moreover, there was no indirect of presence on the likelihood of walking away (p = 0.516) nor the likelihood of shoving or hitting the guy with a bottle (p = 0.511). Consequently, there was no indirect effect of condition on the likelihood of walking away (p = 0.533) nor the likelihood of shoving or hitting the guy with a bottle (p = 0.606). As such, while this model replicates the finding that affect and dispositions directly influence the likelihood of walking away and shoving or hitting the guy with a bottle (Chapter Four), it does not provide evidence for an indirect effect of condition on the likelihood of walking nor shoving or hitting the guy with a bottle.

To summarize the results of this chapter, participants did not differ regarding criminal choice as a discrete option. However, participants in the video condition were significantly less likely to hit the guy with a bottle when assessing choice with the individual Likert variable. Participants in the video condition indicated significantly greater subjective presence than participants in the written condition, but there was no difference in regard to perceived realism. Regarding the open-ended questions, participants indicated more factors that did not fit within the existing framework than did (Bouffard, 2002). However, there was no difference between conditions. Compared to existing categories, factors that were categorized as new deterrents and drivers (e.g., emotions and dispositions) appear to be more influential in predicting the likelihood of a participant indicating that they would either shove or hit the guy with a bottle. Additionally, there was no difference between or within conditions in the amount of factors that did or did not fit with the RCT framework.[89] Finally, in the context of using a video compared to a written vignette, there does not appear to be serial mediation effect (i.e., there was no evidence supporting the mediation: videos increase presence, which in turn increase affect, that then increases the likelihood of shoving or hitting the guy with a bottle).

[89]An additional table in which each individual category (e.g., stigmatic costs, situational benefits) can be found in Appendix D, Supplementary Table S37. At the individual level, more participants in the written condition (7% vs 2%) noted their trust in Lisa as a reason for not committing a crime ($\chi^2(1) = 4.74$, p = 0.03) while more participants in the video condition (10% vs 4%) thought Lisa should have done more (χ^2 (1) = 4.78, p = 0.03).

Discussion

The aim of this chapter was to assess if the way a vignette is presented may: 1) directly influence the behavior a participant would choose and 2) directly influence what factors a participant naturally considers when choosing their behavior. This was achieved by using a between-subjects design in which half of the participants received a vignette in a video format while the other half received a vignette in a traditional written format. Additionally, rather than using close-ended questions, open-ended questions that would allow participants to naturally recall what factors lead to their chosen behavior and discouraged them from choosing other alternatives were used. In doing so, several key theoretical and methodological findings emerged.

Differences in Criminal Behavior

There was no conclusive result that indicated participants differed in the intended behavior based on if they saw a video or read a transcript. Specifically, using the same video as the previous chapter but with a larger sample size, there was no significant difference when assessing criminal behavior as discrete outcome variable. Although there was a significant difference when examining the individual Likert variables, the large confidence intervals point to variability. Specifically, the confidence interval for the mean difference was quite large and the confidence interval for the effect size was nearing zero. As such, this result should be taken with caution. Although previous literature has found a significant difference (i.e., Van Gelder et al., 2019), the medium the vignette was presented in and how the outcome variable was measured differed from the study presented here.

Specifically, as discussed in discussion of Chapter Four, the measure of criminal behavior differed between Van Gelder and Colleagues (2019) and this study. Therefore, the results may have differed if the outcome variables been measured in the same way. Additionally, in their study, Van Gelder and colleagues (2019) compared VR to written vignettes. Due to the COVID-19 interruptions, in this study I had to use an embedded video rather than a fully immersive virtual reality using an HMD. As indicated in the literature review presented within Chapter Four, methodologies will vary in their level of experienced presence and resulting immersion. While a video displayed on a computer screen provides more information than a traditional written vignette, it does not block out external stimuli like an

HMD would. Therefore, different results may have been obtained if a fully immersive HMD virtual reality was able to be used. Because of these differences, it would be an error to state that the findings of this study conflict with other findings.

Serial Mediation

The path-analysis revealed that there was no serial mediation between being in the video condition and the likelihood of walking away nor the likelihood of shoving or hitting the guy with a bottle. Specifically, supporting the findings of Chapter Four, being in the video condition was significantly positively related to subjective presence. However, unlike Chapter Four, neither presence nor being in the video condition had a direct effect on affect (the proxy for state anger). Moreover, being in the video condition did not have an indirect effect on affect. Additionally, neither being in the video condition nor presence had an indirect effect on either outcome variable. Finally, as with Chapter Four, Driving Dispositions (the proxy for trait aggressiveness) was negatively related to the likelihood of walking away but positively related to the likelihood of shoving or hinting the guy with a bottle.

However, as with the discussion on a main effect of condition on criminal behavior above, this result should be taken with caution. Most notably, while the variables of affect and driving dispositions held the same theoretical relationship with the outcome variables as state anger and trait aggressiveness (Chapter Four) they are still only proxies. Moreover, as discussed above, the original serial mediation (Van Gelder et al., 2019) used a different methodology than in this study (i.e., fully immersive VR) and assessed criminal behavior differently. As such, the results here could show the boundary conditions of the serial mediation theory. That is, for serial mediation to occur, it may be that VR has to be used and the outcome variable must be assessed in a specific way. As such, these results should be considered a contributing data point to understanding how presence (elicited through a variety of methods) may influence the amount of anger a participant may feel, and as a result their behavior. Future researchers should continue to test these conditions (e.g., methodologically, and how the outcome variable is assessed) to determine when serial mediation is and is not present.

Differences in Presence and Realism

Participants in the video condition did indicate a greater subjective presence compared to participants in the written condition; however, there was no significant difference in regard to the perceived realism of the scenario. This aligns with the findings in the greater literature (Van Gelder et al., 2019) and Chapter Four. However, as with the difference in criminal behavior discussed above, since the sample was derived from resource availability rather than power analysis (discussed further below), this comparison should be taken with caution.

Open-ended Questions

Several interesting findings emerged from the use of open-ended rather than closed-ended questions. In this discussion I focus on the themes of: 1) factors that did not fit within the existing framework, 2) the existing framework 3) RCT framework, and 4) the modifying role of how a vignette is presented.

Factors That Did Not Fit Within the Existing Framework

Most factors provided by participants did not fit within the existing framework (N = 768, ~70%). Of the useable factors provided by participants that did not fit, the large majority of them center around reoccurring themes and were able to be categorized together as either new deterrents or new drivers (N = 503, 52%).[90] Of these, there were several concepts that are consistent with the greater literature including, affect, dispositions, behavior of the antagonist, the responsibility and retribution paradigm, and stigmatic drivers.

Affect. In the case of affect, some form of anger (e.g., anger, frustration, or annoyance) was continually listed as a reason for participants choosing to either shove the guy or hit him with the bottle. This aligns with the literature that notes a consistent positive relationship between anger and criminal behavior as well as aggression (Berkowitz, 1989; Carmichael & Piquero, 2004; Van Gelder et al., 2019). Interestingly, when participants did indicate another emotion, it was jealousy, another driving aspect that is related to aggression (Edalati &

[90]This statistic excludes the factors provided that were deemed methodological

Redzuan, 2010). As such, this aligns with the other chapters within this thesis highlighting the need for future researchers to examine state emotions in relation to criminal decision-making.

Dispositions. Regarding dispositions, participants indicated their dispositions as both driving as well as deterring factors. This aligns with several studies that note individual dispositions in relation to aggressive criminal behavior. For example, using semi-structured interviews, researchers have observed that some individuals refer to themselves as self-proclaimed non-fighters and when such individuals are exposed to a situation similar to vignette in this study they do not use physical aggression (Graham & Wells, 2003). The category of "Deterring Dispositions" used within this study would align with this. Conversely, researchers have also identified a disposition of recreational fighters that do not hesitate to meet a similar altercation as the one in the vignette with violence (Graham & Wells, 2003). The category of "Driving Dispositions" used within this study would align with this. While a useful framework, neither of these dispositions are validated or precise. It is very possible that there are several precise dispositions that make up the persona of a "non- or recreational-fighter". For example, trait aggressiveness, a more narrow construct, is related to violent criminal behavior (Chapter Four of this thesis; Wells et al., 2011) and may be better suited to distinguishing disposition in the future research. Nonetheless, it is apparent that individual differences influence the likelihood of engaging in violent criminal behavior.

Behavior of the Antagonist. The behavior of the antagonist was an interesting component raised in this study. Specifically, in examining criminal behavior, researchers that take a general approach (i.e., a theory to explain all crime), tend to only examine the perpetrator's disposition and when others are examined, it tends to be in the role of a monitor who enforces rules and norms or as a victim who is or is not placing themselves at risk (e.g., Cohen & Felson, 1979; Wikström et al., 2012). However, the information provided by participants did not fit within these categorizations. When examining the literature on violent behavior in bars similar to the vignette used in this study, one of the primary drivers of a fight is the need to correct a wrong in which the protagonist feels completely justified in doing (Graham & Wells, 2003). In this sense, individuals are likely to engage in a fight when they feel like they have been wronged and need to settle a grievance (Tedeschi & Felson, 1994). The categories of "Driving Behavior of the Antagonist" and "Retribution and Responsibility" within this study would support this finding. General theories of crime may consider adding

and expanding upon additional dimension of a provocateur in inciting crime (for an example see Wikström, 2004) and how this may be best assessed in vignette research.

Driving Stigmas. Additionally, participants also noted that they could not walk away because that would result in a negative stigma. This fear of being viewed as weak or as a coward drove the participant to indicate shoving the guy or hitting him with a bottle (i.e., "Driving Stigma"). Avoiding negative, feminine labels (a driving stigma) is positively related to aggressive behavior in scenarios similar to the one used in this study, and are consider to be just as important as displaying masculinity (a benefit in Bouffard's (2002) framework; Archer et al., 1995; Copes et al., 2013; Hochstetler et al., 2014; Luckenbill, 1977; Neff et al., 1991). Moreover, in situations in which in an altercation is already occurring, as is the case in the vignette used in this study (i.e., participants do not elect to start the altercation but must respond to it), Driving Stigmas have been found to be a key feature promoting violence (Graham & Wells, 2003). As discussed further below, researches may consider examining the perceived costs associated with *not* committing a crime.

The Existing Framework

Of the portion of the responses provided by participants that fit within the existing framework (Bouffard, 2002), they associated with criminal decision-making in the expected direction. Specifically, deterrents were positively related to the likelihood of walking away and negatively related to the likelihood of shoving or hitting the guy with a bottle. The opposite relationship was observed for drivers. However, as indicated above, most factors provided by participants did not fit within the existing framework (~70%). Moreover, when considering the magnitude of effects for the existing framework compared to the new categories, the new categories appear to be better predictors of criminal decision-making. Specifically, the ORs for the new categories were greater in magnitude with narrow confidence intervals. Additionally, the AUC and the R^2 were larger in the new categories than the existing categories by approximately 0.21 and 0.32, respectively. As such, future researchers should consider adapting their assessment to include newer factors discussed above (e.g., affect and dispositions).

However, as continuously emphasized throughout this thesis, this should not be taken as means to completely remove the traditionally assessed factors from research designs or

analysis – to do so would be an error. Specifically, the combined model (i.e., both existing and new) outperformed either singular model. Most importantly, this outperformance was most notable in the increase in sensitivity of the logistic regression models. That is, a combined model does a better job of identifying when a person would commit a crime, than either individual model. While each crime will undoubtedly have specific predictors (e.g., trait aggressiveness may be more influential in assault than white collar crime), it is plausible that a set of predictors may be more universal than others. Future researchers should tease apart which factors (e.g., Existing vs. new, RCT vs. non-RCT), culminate in the greatest predictive power of correctly identifying when a person would and would not commit a crime using a variety of methods examining different crime types.

RCT Framework

In support of the integration of distal and proximal theories—a developing portion of the literature and one of the main purposes of this thesis—factors that did (e.g., legal costs) and did not fit within the RCT perspective (e.g., dispositions as well as indicators of intuitive decision making such as emotions) equally predicted the odds that a participant would indicate to shove or hit the guy with a bottle.

Interestingly, although several factors provided by participants were easily categorized as fitting within the RCT perspective, they are not traditionally assessed. Most notably, these were factors that were diametrically opposite to the traditional assessment such as, *driving* stigmas, *deterring* benefits, and *driving* costs. That is, empirically, the RCT perspective tends to primarily focus on costs associated with committing a crime like a negative stigma and the benefits of committing a crime like material gain. However, participants noted that there were several costs associated with not committing a crime, including "being hit first…Lisa being hurt…Lisa may think I don't care" as well as the negative stigma of not fighting and being perceived as a "coward". Additionally, participants indicated several benefits of *not* committing a crime such as "I would look more mature and impress Lisa".

While fitting within the RCT framework, this mirrored dichotomy of costs and benefits is something not traditionally discussed in the literature and indicates a different type of thought process. That is, rather than simply focusing on the costs and benefits of the crime, when deliberation does occur, participants also consider the costs and benefits associated with law-

abiding behavior. In essence, these costs and benefits of both law-abiding and criminal alternatives are two sides of the same coin. While the comparison of costs and benefits between law-abiding and criminal alternatives is a fundamental principle of RCT, the costs and benefits of law-abiding behaviors are traditionally left unmodelled in empirical research. It is possible that this finding is more apparent here compared to traditional studies due to its design (i.e., a discrete outcome variable). That is, participants were presented with several alternatives and had to choose a course of action. In similar studies, participants are normally presented within only one alternative and asked the likelihood of exhibiting that behavior. By requiring participants to consider multiple alternatives at a single point, they may have been more likely to consider the costs and benefits of the law-abiding alternative.

Finally, two factors ("Hitting a Man with a Bottle is too Aggressive" and "Cognitive Trade off/Balancing Act") were provided by participants. While clearly indicating some for evaluation and thus theoretically aligning with the RCT perspective, I argue these factors are artefacts of the study design. Since participants had to choose between three options (i.e., walk away, shove the guy, or hit the guy with the bottle), this arguably lead to a natural evaluation of each potential alternative, resulting in phrases such as "hitting with a bottle is too much". Such a result would not be observable in traditional studies that only have participants indicate the likelihood of one behavior on a Likert-scale or if participants were allowed to freely choose any behavior that came to mind. Similarly, each option could be placed on a continuum of aggressive behavior, with walking away and hitting the guy with a bottle on opposite extremes and shoving the guy being the middle. As such, participants may have naturally been drawn to the middle option, resulting in factors that aligned with "Cognitive Trade off/Balancing Acts".[91]

Influences of Vignette Presentation

Finally, in addition to examining if participants naturally considered factors different from the factors traditionally examined by researchers, I also sought to examine if experiencing a vignette modify this difference. In doing so, this would test the boundary conditions of existing assessments in regard to newer methodologies (i.e., VR and videos). By understanding

[91] It should be noted that the visual presentation of each option in both conditions was randomized, thus minimizing the possibility that participants just chose the physical middle option.

these boundary conditions, researchers can modify their assessments where necessary to better model criminal decision-making based on methodology and increase overall accuracy. When comparing the raw number of factors provided, there were no between-groups differences regarding the type of responses participants provided. That is, participants in the video and written conditions did not differ in regard to the amount of factors provided that fit in the existing categories, new categories, the RCT framework, nor factors that did not fit within the RCT framework. Moreover, experiencing the vignette as a video did not modify the relationship between these predictors and the odds of shoving or hitting the guy with a bottle.

To summarize the discussion, although participants in the video condition indicated a greater subjective presence compared to participants that read the same vignette, there was no difference regarding perceived realism. Additionally, there was no direct influence of condition on the likelihood of aggressing, nor was there an indirect effect (serially mediated or otherwise). Finally, although participants indicated that they naturally considered a number of factors that are traditionally examined by researchers, they naturally considered more factors that are not, regardless of how a vignette is presented. Moreover, these new factors are arguably better predictors of criminal behavior compared to the traditional factors.

Limitations

The results of this study should be taken with some caution as the sample size was derived from convenience and resource availability, rather than being driven by a formal power-analysis. Although previous research has examined similar research questions regarding open-ended questions with similar methodologies, there is no direct comparison. Depending on if deterrents and drivers are examined, effect sizes range from d = -3.793 to -1.196 (Study 1; Exum & Bouffard, 2010). Taking the smaller effect size of -1.20, with the current sample size of 359 (N_{video} = 177, $N_{written}$ = 182) analyses were operating with 100% power. However, the effect size for a main effect of how a vignette is presented (e.g., VR versus written) on criminal intention, is much smaller (d = 0.18; van Gelder et al., 2019). Considering an effect size of d = 0.18, with the current sample size of 359 (N_{video} = 177, $N_{written}$ = 182), analyses were only operating with 50% power. As such, and as reflected in the discussion, the conclusions drawn regarding a main effect should be taken with caution.

The categorization of open-ended response questions could have occurred differently than presented here. That is, every researcher will view any data set with their own biases that will influence their categorization (e.g., Philpot et al., 2019). By using two independent researchers familiar with this literature, I sought to minimize this individual bias. Moreover, by providing a discussion and coding example (Table 19, Coding) I have aimed to explicate how decisions were made between the two researchers (e.g., Sandelowski, 1995). My hope is to ensure a transparent reasoning and justification for each conclusion drawn.

Similarly, although I have used the term "existing framework" throughout this chapter to describe the categorization set forth by Bouffard (2002) it should not be considered the "discipline standard". That is, there a number of researchers that examine other factors that do not appear within the existing framework (as demonstrated by the ability to situate the new categories in the greater literature above). However, I found this framework to be the only systematic attempt at examining 1) what factors researchers typically assess when using vignettes and 2) what factors people naturally consider. As more researchers examine different predictors of criminal decision-making that do not fit within this framework, such as emotions, other factors may become more standard and a new framework established.

Consequently, the results of the study should not be over generalized to various crime types or different "frameworks". Specifically, the scenario chosen in this study possessed a physically violent element. Had the scenario instead focused on some form of drug, theft, destruction, white-collar, or otherwise organized crime, participants may have differed in regard to criminal behavior as a function of how the vignette was presented. Moreover, the responses provided by participants may have fit better (or worse) within the existing framework (Bouffard, 2002). Additionally, those that potentially did not fit within the existing category may have centered around different themes than the ones presented here. As such, researchers should ensure to replicate these findings using various scenarios that use different crime types.

Although open-ended response quality was not an issue within this study nor within the greater literature (Lovett et al., 2018), some participants indicated that the timing element (the question auto-advancing in two minutes) disrupted their writing. Additionally, some participants did not respond to the open-ended questions at all. Outside of the possibility that the participant simply left the information blank, other aspects could have led to this. Specifically, through Prolific Academic's messaging service, some participants informed me

that they first write all qualitative answers in Microsoft Word to ensure "that there are no errors and to reach a decent character limit" (although no character requirement was indicated in this study). Other participants simply missed that there was a timing element and did not write within the two minutes provided and some even indicated two minutes was not enough and had much more to say. Where participants original data cell for the open-answered questions was empty (i.e., appearing no data was provided), three participants messaged through Prolific Academics anonymous messaging service providing their responses. Their responses were matched to their data using their Prolific ID. Nonetheless, future research should ensure that the timing element is made explicit (e.g., by including a countdown clock) and prompt participants to *not* write their answers in another program and transfer it over.

Additionally, although novel and creative, the use of open-ended questions potentially introduces an element of bias. For example, participants may not have the ability to accurately recall what drove them to their behavior. For example, It could also be argued that due to the two minute time span, participants could have used motivated reasoning (e.g., Kunda, 1990) to provided either socially desirable responses or responses that would allow them to preserve their moral identity (e.g., Shalvi et al., 2015; Sykes & Matza, 1957). In either case, this motivated reasoning would potentially cause participants to indicate some factors drove their decision-making and behavior when they actually didn't at the time. Although unconscious or conscious motivated reasoning could not reasonably be controlled, since participants were asked to recall their motivations minutes (or in some cases seconds) after choosing their behavior, the possibility of forgetting is minimized. Moreover, as with Chapter Four, to reduce any potential "cooling-off" period, I placed the decision-making point directly into the vignette medium (Van Gelder et al., 2019). Nonetheless, it is possible that the "real" motivations behind a participants behavior may be different than the ones described here.

As the video used in this chapter was the same stimulus in Chapter Four, some limitations are shared. Specifically, the fact that the Dutch actors spoke English without an English accent may have modified the results here in regard to presence or realism. Additionally, had the discrete options available not been driven by video availability and the possibility of branching, other more appropriate alternatives may have been included. Additionally, as noted in Chapter Four, the difference in the attractiveness of Lisa and other factors that had to be imputed by participants in the written condition but not by participants in the video condition were not controlled for. Such factors may modify the results presented here.

Finally, participants in both the video (N = 5, 3%) and written condition (N = 9, 5%; $\chi^2(1) = 1.08$, $p = 0.30$) indicated that they needed more information about the scene to really decided what they would do. On examination of these data points, the five participants in the video condition indicated they needed more information about the relationship between the antagonist and Lisa to make an accurate decision. Four participants in the written condition indicated that they simply needed more information to make a decision without specifying what kind. Finally, the remaining five participants in the written condition indicated that they desired to know Lisa's reaction to the scenario and that it would have guided their decision-making.

Although researchers cannot accommodate every permutation or include every minute detail that participants may want to guide their decision, this is more attuned to real-life decision-making in which we as humans are constantly acting in a state of bounded-rationality with incomplete information (e.g., Simon, 1957). However, the inability to know Lisa's reaction, a parameter exclusively highlighted by participants in the written condition, indicates a limitation of the written scenario that does not reflect real life. That is, in real life someone may not know the relationship between two people but they would be able to determine someone's reaction in one way or another (e.g., facial responses). Nonetheless, as indicated in the discussion of Chapter Four, while videos and VR are meant to provide a wealth of information, they are still limited in the number of permutations and what information is provided is ultimately up to the researcher. As such, as researchers begin to use new technology to assess criminal decision-making, consideration should be given to what type of information is (or is not) provided to participants, and how this may influence their decision-making process.[92]

Conclusion

In this chapter I sought to examine how the way a vignette was presented may influence the behavior a participant chooses and what factors influence their decision-making process. There was no difference regarding what behavior was chosen nor what factors were considered by participants based on how the vignette was presented. However, the factors that participants

[92]This recommendation should not be considered synonymous with experimentally manipulating the information provided in a vignette to test theories (e.g., the presence of a police officer acting as a monitor). Instead, this recommendation is highlighting the fact that seemingly unimportant, or at a minimum not theoretically driven, information may influence a participant's decision-making, and thus results (e.g., what Lisa's reaction was).

naturally considered did differ from those traditionally assessed by researchers and are arguably more influential in regard to criminal decision-making. Nonetheless, participants did provide factors that fit within the existing framework that were significantly related to criminal behavior. Future researchers should tease apart what factors have the greatest predictive power under what conditions.

Chapter Six: General Discussion

The aim of this doctoral thesis was to integrate psychological and criminological theory to better understand criminal decision-making. Specifically, using a wide range of methods, I sought to expand and align traditional proximal theories from criminology (e.g., Cornish & Clarke, 1986) with dual-process models of decision-making from behavioral economics and social psychology (e.g., Gigerenzer & Gaissmaier, 2011; Kahneman & Tversky, 1979; Metcalfe & Mischel, 1999; Sloman, 1996; Strack & Deutsch, 2004; Thomas & Mcgloin, 2013). Additionally, to create a more comprehensive model of criminal decision-making, I sought to integrate this expanded proximal approach with distal theories, namely trait self-control as defined in psychology (e.g., Maloney et al., 2012; Mamayek et al., 2015). Finally, to advance new knowledge about the methods by which criminal decision-making are typically assessed, I examined how novel VR and video methodologies differ from traditional written vignettes in regard to how present a participant felt within a scenario. Additionally, I used open-ended questions rather than closed-ended questions to examine what factors people consider naturally when making decisions.

In Chapter Two, using a large-scale online survey and Structural Equation Modeling (SEM), I showed that intuitive decision-making, a factor not traditionally modeled in proximal theories, holds a significant positive association with criminal behavior (McClanahan et al., 2019). In Chapter Three, using a standard ego-depletion task there was no main effect of ego-depletion on criminal behavior (McClanahan & van der Linden, 2020). However, perceived risk, a central tenant of Rational Choice Theories (RCT), predicted criminal behavior for participants in the control condition, but not for depleted participants. Replicating the findings of Chapter Three, in Chapter Four, participants depleted of their self-control did not indicate greater criminal behavior. Additionally, there was no main or indirect effect of VR on criminal behavior. Nonetheless, participants that experienced the vignette in VR indicated a greater subjective presence compared to participants that simply read a text describing the same scenario. Subjective presence was in turn related to higher levels of state anger which was positively related to the likelihood of criminal behavior. Finally, complementing the results of Chapter Four, in Chapter Five, participants that watched the video of the hypothetical scenario indicated more subjective presence than participants that read a text describing the same scenario. However, presence was not related to anger. Moreover, there was no direct nor indirect effect of watching the vignette as a video on criminal behavior. Additionally, in

Chapter Five I took a qualitative approach and used open-ended questions to examine what factors people naturally consider when making decision. Although a number of factors provided by participants fit within an existing proximal framework (Bouffard, 2002), the majority of factors provided did not but align with a number of other theories. The theoretical and practical implications of these findings are collectively discussed below.

Expanding Proximal Theories

As indicated in Chapter One, traditional proximal approaches take the rational decision-making perspective in which people seek to maximize gains and minimize loses. Although accepting that this cognitive process may be imperfect (e.g., due to time constraints, limited information, and the subjective value placed on potential outcomes), what is clear is some form of calculation, however rudimentary it may be. While a useful starting framework, such an approach is limited both theoretically and pragmatically. In this doctoral thesis I have demonstrated that humans are driven by intuitive factors that do not fit within a rational framework (e.g., norms, visceral emotions, and heuristics). Moreover, I have also demonstrated an apparent mirrored dichotomy to the traditionally examined costs and benefits of a crime, that is, the costs and benefits of non-criminal behavior.

In Chapter Two, a trait measure of intuitive decision-making was positively associated with Self-Reported Criminal Behavior (SRCB). In Chapter Three, positive affect and perceived social consensus of acceptability were significantly positively related to criminal behavior and negative affect was significantly negatively associated with criminal behavior. Finally, in Chapters Four and Five, state anger was significantly positively related to criminal behavior. None of these significant predictors can be accommodated by traditional proximal theories.

When examining factors indicative of rational decision-making and traditional proximal theories (i.e., perceived risk) in relation to factors related to intuitive decision-making (e.g., emotions, heuristics, and norms), the predictive power of perceived risk was never greater than other factors and in some cases it was a significantly weaker predictor. For example, in Chapter Three, although perceived risk was negatively associated with criminal behavior in the control group, the magnitude of the association between positive affect and criminal behavior as well as the magnitude of the association between negative affect and criminal behavior was significantly greater than that of perceived risk (McClanahan & van der Linden, 2020).

Additionally, in Chapter Five, in both the video and written conditions, factors that did not fit within a RCT framework were comparable to factors that did fit within the RCT framework in terms of predictive power and overall model fit. For example, participants prominently noted factors surrounding the behavior of the antagonist as a reason for the behavior they chose. A number of participants indicated that the man looked aggressive. For some participants this deterred them from engaging in aggressive behavior and for others it drove them to aggressive behavior. Regardless of whether it was a deterrent or driver, this information was not evaluative nor calculative, and appeared to be more formulaic and heuristic-like with participants indicated a simple input-output type of processing. Similarly, some participants indicated they may only view one single option when posed with the possibility of committing a crime (i.e., "The Right/Best/Only Thing to Do"; Table 20). In this context, participants often indicated that walking away was the right, best, or only option. This wording does not evoke the same moral underpinning of phrases such as "I don't believe in violence" that would potentially highlight an internal difference (i.e., distal theories), nor does indicate some sort of calculation. Instead, this concept aligns more with a default or heuristic based parameter that does not fit within the traditional proximal framework.

An interesting dynamic between the cost and benefits associated with criminal and law-abiding behavior emerged from the open-ended questions in Chapter Five. Specifically, theories from an RCT perspective highlight the cognitive trade-offs between both law-abiding and criminal outcomes. However, the empirical examination of such theories tend to only focus on the costs (e.g., risk of getting arrested) and benefits (e.g., material or psychological gain) associated with the criminal alternative (Exum, 2002). Participants in Chapter Five indicated a number of factors that could easily be considered a cost of choosing law-abiding behavior (e.g., being viewed as a coward) as well as several benefits of law-abiding behavior (e.g., no one getting hurt).

Some may argue that these concepts are the same as costs and benefits of committing a crime but simply differ due to word selection and phrasing. For example, the cost of walking away and looking like a coward could be rephrased as the benefit of shoving the guy and not looking like a coward. One could rephrase the benefit of no one getting hurt by choosing to walk away as the cost of someone getting hurt as the result of shoving the guy.

However, I argue to do so would misrepresent the underlying decision-making process that researchers aim to accurately model. Specifically, humans model costs and benefits differently, and reframing a cost to a benefit (or vice versa) results in different behaviors and outcomes (Kahneman & Tversky, 1979; Kühberger, 1998; Ruggeri et al., 2020; Tversky & Kahneman, 1981). Similarly, it is argued that positive attitudes towards an object or stimulus should not be considered the simple opposite of negative attitudes towards the same object or stimulus. Specifically, positive attitudes are better considered approach-motivation factors, while negative attitudes are best considered avoidance-motivation factors (e.g., Cacioppo & Berntson, 1994; Fredrickson, 2001; Pittinsky et al., 2011). Taken collectively, the fact that people are specifically highlighting a cost (e.g., looking like coward) indicates a specific motivating factor different from seeking gain (i.e., loss aversion; Kahneman & Tversky, 1979). Reframing it may misrepresent the thought process and any resulting theory or policy may be limiting its effectiveness. For example, prevention strategies aimed at reducing real-world criminal behavior highlighting only the risk associated with crime and minimizing or removing any potential reward (e.g., Clarke, 1997) may be limiting their effectiveness. By including elements that highlight the benefits of not committing a crime or the minimizing the costs associated with not committing a crime, such strategies may increase their effectiveness.

To summarize, although traditional proximal theories use a rational, albeit imperfect, decision-making process as a framework to describe human behavior, in this thesis I have highlighted the need to expand such a framework. Specifically, I have demonstrated that above and beyond traditional deterrence factors such as the risk of apprehension, intuitive components such as emotions and heuristics influence criminal decision-making. Moreover, in addition to the factors surrounding criminal behavior, researchers need to be able to capture and model the effects of the costs and benefits associated with law-abiding behavior that influence decision-making.

Integrating Distal and Proximal Theories

In a similar vein, this thesis aligns with the greater literature highlighting the importance of integrating distal and proximal approaches (Mamayek et al., 2015; Nagin & Paternoster, 1993; Paternoster & Pogarsky, 2009; Thomas & Mcgloin, 2013; Van Gelder & De Vries, 2014). By allowing these two perspectives to remain independent of one another their explanatory power is reduced, potentially reducing the utility of any policy derived from a

singular approach. Unifying the two frameworks and understanding how the parameters behave when controlling for one another is required to overcome such problems and to develop a more comprehensive model of criminal behavior.

Supporting the notion that both individual differences and proximal decision-making factors are important for understanding criminal behavior, in all the chapters presented in this thesis a number of dispositions as well as proximal factors were observed to relate to criminal behavior. Most importantly, these relationships were observed simultaneously (i.e., controlling for the effects of one another). In Chapter Three, regardless if a participant was depleted or not, trait self-control as well as emotions and perceived norms were significantly related to criminal behavior. In Chapter Four, the proximal factors of state anger and perceived risk were positively and negatively related to criminal behavior, respectively, while trait aggressiveness was positively related to criminal behavior. Finally, in Chapter Five dispositions alongside several proximal factors were freely recalled by participants as reasons for why they did and did not engage in the criminal alternative.

Specifically, in Chapter Five, 25% of participants indicated that they were not the type to engage in physical contact. In an exploratory analysis it was revealed that a deterring disposition (OR = 0.51, 95% CI [0.39, 0.67], $p < 0.001$) and driving disposition (OR = 1.50, 95% CI [1.11, 2.04], $p = 0.008$) were positively and negatively related to the odds of shoving or hitting the guy with a bottle, respectively. The remaining deterrents and drivers were then added to the model. Deterrents were significantly negatively related to the odds of shoving or hitting the guy with a bottle (OR = 0.25, 95% CI [0.16, 0.40], $p < 0.001$). Conversely, drivers significantly positively related the odds of shoving or hitting the guy with a bottle (OR = 11.08, 95% CI [5.91, 20.80], $p < 0.001$). While deterring dispositions remained significant, (OR = 0.55, 95% CI [0.39, 079], $p < 0.001$) driving dispositions were no longer significant ($p = 0.169$). This may be due to the limited number of participants that indicated their disposition drove them to either shove or hit the guy with a bottle (5%). Nonetheless, and more importantly, a combined model (i.e., dispositions and proximal factors) outperformed a model without the dispositions ($\chi^2(1) = 16.40$, $p < 0.001$) as well as model that only included the dispositions ($\chi^2(2) = 195.00$, $p < 0.001$). Additionally, the combined model had the greatest predictive validity (AUC = 0.92).

Finally, the above dispositions also raise an interesting question more generally within the field. Specifically, distal theories tend to isolate a specific characteristic in relation to crime (e.g., self-control, morality, or trait aggressiveness). However, some of the comments provided by participants in Chapter Five evoked a broader sense of identity, as either one who would or would not do something (in this case shove or a hit a guy with a bottle). Importantly, such broad statements provided by participants did not necessarily cite a specific distal construct such as self-control or trait aggressiveness, but instead implied a behavior did or did not align with who they are as a person. This aligns with the greater Selfhood and Identity literature within psychology. Such a sense of self is suggested to drive decision-making, motivations, and behaviors more generally (e.g., Tajfel, 2010; Abrams & Hogg, 2006; Hogg, 1992; Cross & Markus, 1990; Mead, 1934; Cooley, 1902).

Taking such literature into account, in the context of criminal behavior, people may or may not commit crimes because such behavior is (in)congruent with who they are as a person. For example, the Integrated Psychosocial Model of Criminal Social Identity describes the development of a criminal identity in early-life with an emphasis on group membership and the need for self-esteem (Boduszek et al., 2016). Similarly, it is well-established that for desistance to occur an offender must transform their identity from that of a 'criminal identity' to a 'non-criminal identity" (e.g., Maruna, 2001; Ray Paternoster & Bushway, 2009; Boduszek et al., 2020). Thus, although this thesis, and the greater literature more generally, isolates and tests specific characteristics in relation to criminal behavior, it is important that we do not discard the individual themselves, as selfhood may play a key role in understanding criminal behavior.

Taken collectively, these results highlight the importance of modeling both dispositions and situational factors when examining criminal behavior. As I have consistently demonstrated throughout this thesis, both dispositions and situational factors remain significant predictors even when adjusting for the effects of one another. Moreover, a combined model outperforms either singular model. However, researchers may wish to consider broadening their distal factors to be more encompassing (e.g., selfhood). In doing so, researchers may find a more unifying theory that accounts for dispositional factors such as self-control and morality,

proximal factors such as risk and affect, as well as more sociological factor such as norms and group membership.[93]

State Self-control and Criminal Behavior

An additional aim of this thesis was to examine how the traditionally examined trait self-control construct may both directly and indirectly influence criminal decision-making when modeled as a dynamic state factor. In doing so, I was able to shed light on how state self-control may indirectly influence criminal behavior by modifying how situational parameters are perceived and influencing what information people attend to under what circumstances (e.g., Van Gelder & De Vries, 2016). Additionally, although not a principle component of this thesis, the results presented here provide useful information to the heavily debated ego-depletion literature more broadly.

Using a standard ego-depletion task, in Chapter Three and Four, I demonstrated that although participants indicate a successful depletion there is no main effect on criminal behavior. However, in Chapter Three, perceived risk was significantly negatively related to criminal behavior for participants in the control condition but held no relation to criminal behavior for depleted participants. Additionally, using data from Chapter Four, an exploratory analysis revealed that risk was a significant positive predictor of the odds of shoving or hitting the guy for participants in the control condition, but not depleted participants (Appendix D, Supplementary Table S38).[94] Conversely, state anger was a significant predictor for depleted participants, but not participants in the control condition. This indicates that while fluctuations in state self-control may not directly influence the amount of criminal behavior, it can influence what factors are considered when making a decision.

This finding aligns with the ego-depletion literature more broadly that indicates when depleted, participants are less likely to use deliberation and more likely to be driven by factors such as emotions and heuristics (Hamilton et al., 2007; Schmeichel et al., 2003). Moreover,

[93] This should not be taken as a call for developing a "criminal typology" nor should it be seen as suggesting a criminal identity that is unyielding and static. Instead, it implies the possibility of larger, dynamic, multi-faceted construct that needs attention within criminology compared to the traditional few distal characteristics that are examined. Such a construct can be quantified and tested through the use of SEM and longitudinal studies (Boduszek et al., 2016).

[94] As indicated throughout Chapter Four, the sample size was underpowered. As such, this exploratory analysis should be taken with caution.

this finding provides key empirical support for the notion that state self-control will modify what information people will attend to in the context of criminal decision-making (e.g., Van Gelder & De Vries, 2014; Wikström & Treiber, 2007). Specifically, Chapter Three demonstrates that in a moment when self-control is low, although participants are no more or less likely to commit a crime, traditional proximal factors (e.g., perceived risk; Cornish & Clarke, 1986) do not predict their behavior. Conversely, parameters such as emotions remain significant predictors (McClanahan & van der Linden, 2020).

The inability to detect a main effect holds implications for both the general ego-depletion literature and criminal decision-making more specifically. As indicated in the discussion of Chapter Three, the ego-depletion effect may not exist, or at least not the degree that is traditionally suggested (Baumeister, 2019; Carter et al., 2015; Dang et al., 2020; Hagger et al., 2016). However, I believe a more likely explanation may be found in the abstract nature of tasks often used in the literature as outcome measures. That is, researchers tend to use tasks that either are explicitly not criminal (e.g., giving a researcher a bad review) or abstractly aggressive (e.g., a blast of loud white noise). Therefore, the ego-depletion effect may only work under certain situations with certain outcome variables. Generalizing these findings to variables that either tap into actual criminal behavior or clear physical assaults may be too far of a leap. As such, researchers need to proceed with caution with applying ego-depletion techniques to more concrete outcome measures.

In regard to the criminal decision-making literature, the results of this study indicate that self-control should not be the only dispositional factor researchers examine in relation to criminal behavior. Moral groundings or internal norms held by an individual should be examined as well. As suggested in the discussion of Chapter Three, such moral principles may moderate the influence of ego-depletion. That is, there may only be an ego-depletion effect on criminal behavior when an individual does not have strong moral grounding either for (always) or against (never) a particular criminal behavior (e.g., Yam et al., 2014). This aligns with theories such Situational Action Theory (SAT; Wikström et al., 2012) which proposes that such a distal trait would directly influence criminal behavior.

While such a proposition may find support through extensive interviews (as was the case with SAT; Wikström et al., 2012), such a construct may be difficult to examine within a laboratory or experimental setting. Asking participants about their moral standing on criminal

behavior *before* exposing them to a hypothetical scenario followed by asking them what they would do in that scenario may prime participants to indicate a behavior congruent with what they indicated their moral standing to be. Similarly, by asking participants their moral standing on criminal behavior *after* asking them what they would do in a hypothetical scenario may prime participants to align their moral standing with the behavior they indicated. In either case, researchers may be inadvertently causing and measuring *explicit contamination* (e.g., Beauregard et al., 1999). For example, participants may seek to align their moral grounding and indicated behavior in order to prevent cognitive dissonance (Festinger, 1957). This in turn may lead to an inflated effect size.

Others may argue that moral principles should be examined more broadly to reduce potential contamination effects. A number of measures exist and would need to be considered in terms of trade-offs, research question, and general methodology, (Ball, 1973; Mills et al., 2004; Shields & Simourd, 1991; Simourd, 1997). Conceptually, these measures tap into a similar construct of general attitudes that directly promote criminal behavior such as, Neutralizations, Attitudes towards the police, and Identifying with criminal others (Bonta & Andrews, 2016). While potentially reducing contamination effects, such measures come with a different set of limitations.

For example, Neutralizations (guilt reducing mechanisms used to rationalize criminal behavior; Sykes & Matza, 1957), are tautologically debated. That is, it isn't clear if holding Neutralizations as an attitude leads to criminal behavior, or vice versa (Conklin, 2004). Additionally, attitudinal formation regarding police is a complex topic (Mbuba, 2010; for a review see: Brown & Reed Benedict, 2002) and individuals may hold negative attitudes, but this should not be considered synonymous with a greater propensity to commit a crime (Banse et al., 2013).

A more promising measure has recently emerged in the personality literature, namely the Honesty-Humility index of the HEXACO personality framework (Lee & Ashton, 2004). Although very similar to the more well-known Big Five or Five Factor Model (Goldberg, 1990; McCrae & Costa Jr., 1990), the HEXACO model includes an additional sixth facet, Honesty-Humility. This facet encompasses individuals' interpersonal genuineness, (un)willingness to use fraud or take advantage of another for personal gain, (un)interest in material or status gains,

and overall modesty. It has been observed that the Honesty-Humility index is negatively related to criminal behavior (Van Gelder & De Vries, 2012, 2014), as well as positively and negatively related to perceived risks and benefits, respectively (Weller & Tikir, 2011). However, of the 16 items within the index, 4 of them directly mention a criminal behavior, potentially contaminating the results. The remaining items may more directly align with theories such as Anomie or Strain (e.g., Agnew, 1992; Merton, 1938) and may situate better within sociological frameworks rather than an individual difference, such as self-control. Nonetheless, researchers could use this index as a beginning framework to develop a measure to expand on the interaction of state self-control and morality.

In sum, this thesis did not find support for the notion that participants depleted of their self-control were more likely to indicate criminal behavior than participants in a control condition. Such a finding highlights potential limitations within the ego-depletion more broadly. However, participants that were depleted were not driven by perceived risk, but instead driven more by affect and perceived social consensus of acceptability. This aligns with the greater ego-depletion literature and provides a useful empirical answer to the questions of "what information when" posed by researchers (e.g., Van Gelder & De Vries, 2014; Wikström & Treiber, 2007). In regard to a main effect of state self-control on criminal behavior, some have suggested that such a main effect may be observed for people that are do not hold strong morals against a particular behavior (Gino et al., 2011; Van Gelder & De Vries, 2012, 2014; Study 3; Wang et al., 2017; Yam et al., 2014). Morality may be a useful individual difference for researchers to look at more generally when assessing criminal decision-making, but also specifically when looking at the moderating effects of state self-control.

Assessment of Criminal Decision-making

In addition to contributing the theory of criminal behavior, in this doctoral thesis I sought to contribute to the method of assessment as well. Specifically, although the vignette methodology is one of the main ways of experimentally assessing criminal behavior, it is not without its limitations, most notably in regard to the ability to effectively communicate the nuances of real-world scenarios (Van Gelder et al., 2014). Moreover, the traditionally used closed-ended questions may limit a researcher's ability to understand what drives criminal behavior. To address these two aspects, in this doctoral thesis I examined how presenting a vignette in VR, as video, or as a traditional written vignette differed in regard to presence,

realism, and criminal behavior. Additionally, using open-ended questions, I examined if participants naturally consider the factors researchers tend to ask about.

Presence and Realism

In Chapters Four and Five participants in the VR and Video condition indicated a greater subjective presence than participants in the written condition. However, there was no difference between conditions in regard to realism. As indicated in the discussion of Chapter Four and Five, this may be due to the fact that vignettes are specifically designed to be realistic and that realism may tap into a different construct outside of feeling present within the scenario (Van Gelder et al., 2019). Nonetheless, it was consistently observed that participants in the written conditions indicated a lower amount of subjective presence.

Using a combined data set from Chapters Four and Five, an exploratory one-way ANOVA (VR, video, and written) revealed there to be a large main effect of condition on indicated subjective presence ($F(2, 478) = 20.39$; $R^2 = 0.07$; $d = 0.59$, 95% CI [0.41, 0.77]; $p < 0.001$). Post-hoc analysis revealed that participants in the VR condition indicate significantly more presence than participants in the video condition ($M_{vr} = 37.91$, $M_{video} = 34.29$, $M_{diff} = 3.62$¸ $p_{tukey} = 0.045$) and significantly more presence than participants in the written condition ($M_{written} = 30.95$, $M_{diff} = 6.96$¸ $p_{tukey} < 0.001$). Additionally, participants in the video condition indicated significantly more presence than participants in the written condition ($M_{diff} = 3.33$, $p < 0.001$). However, there was no difference between groups in regard to perceived realism ($d = 0.20$, 95% CI [0.00, 0.37]; Appendix D, Supplementary Table S39; Appendix E, Supplementary Figure S24).[95]

Importantly, it should be noted that due to COVID-19 interruption, there are only 46 participants within the VR condition, as such the results presented here should be taken with caution and used as a springboard for future research comparing the different methodologies. The finding that presence was highest in the VR condition is in congruence with the greater literature (e.g., Schubert et al., 2001; Van Gelder et al., 2019). Nonetheless, the fact that the video achieved similar levels of presence indicates that in a temporal or financial constraint,

[95]Analyses were conducted only on the control group of each condition (i.e., no depletion).

and when researchers are not concerned with interactivity or creating a branching narrative, videos may serve as a suitable alternative to fully immersive VR.

Criminal Behavior

There was no conclusive evidence regarding a difference of criminal behavior as a function of how the vignette was presented (VR, video, or written). Specifically, in Chapters Four and Five, there was no difference in criminal behavior when using a discrete outcome variable nor when assessing the more granular Likert outcome variables of just walking away or shoving the guy. However, in both chapters, participants in the written condition indicated a greater likelihood of hitting the guy with a bottle as a Likert outcome variable.[96]

These findings raise an interesting line of research regarding differences in outcome variables when using different methodologies. The findings in this thesis contradict the one known study directly comparing VR to written outcomes.[97] As indicated in the literature review of Chapters Four and Five, when using VR, participants indicate higher criminal intentions than participants in a traditional written condition (Van Gelder et al., 2019). However, in this thesis there was no conclusive evidence of a difference in criminal choice based on how the vignette was presented. It is important that as a field we understand if simple methodological changes will have a main effect on the outcome variable of interest. Simply put, if one researcher uses methodology A and another uses methodology B (which is conceptually similar), but each researcher concludes something different – who is correct? Although is an overly simplistic example, it illustrates the point clearly. If it is possible that different conclusions are derived from different methodologies that are presumed to do and measure the same thing (e.g., VR, videos, and written vignettes), we must know this as field, especially considering the potential policy implications resulting from any study.

I believe a key portion to this debate will be found in the intention-behavior gap literature. Specifically, it is critical to remember that neither VR nor written vignettes assess real-world behavior but are understood to be reasonable proxies. Focusing solely on the

[96]It should be noted that on 1 (Not at all likely) to 7 (Extremely likely) scale, participants in the written condition only indicate an average likelihood of 2.27 (Chapter Five) and 1.65 (Chapter Four). Thus, while the difference is significant, practically the likelihood is still very low.
[97]It must be noted that although conceptually the same, the outcome variables are assessed differently.

potential mechanisms that reduce ecological validity, it could be argued that the use of VR creates an alternative reality that allows participants to exhibit a certain behavior that they would not in the real world (e.g., Escapism; Holl et al., 2020). That is, as there is no *real* consequence as a result of their behavior, individuals are willing to do things that they would not do in real life. This would create a large intention-behavior gap from the laboratory to the real world. However, this is not unique to VR, as the same fact could be argued for *any* methodology that does not assess real-world behavior. Additionally, when comparing a written scenario to real-world behavior, researchers observed that of the participants that indicated they would commit the crime, in reality none did (Study 1; Exum & Bouffard, 2010). That is, people indicated *higher* levels of criminal intention when exposed to a written vignette than they actually did in real life.[98] It could be that people indicate greater criminal choice in a written condition because written vignettes do not communicate the nuances that occur in daily life and reduce subjective presence. This could explain the intention-behavior gap from the laboratory to real world observed in the study above. Therefore, both methodologies are likely to have some form of discrepancy when compared to the real world. Moreover, the intention-behavior gaps derived from either method are susceptible to moderating factors such as specificity, time-frame, and volitional control (e.g., Fishbein & Ajzen, 1975).

Taking the above points into consideration, the question then becomes, which methodology is more representative of real-world behavior. If different conclusions are drawn because different methodologies are used, then I argue that it is the methodology that best approximates real-world behavior that should be given priority (e.g., the smallest intention-behavior gap). However, considering that research within this area is so nascent, it would be premature to conclude whether VR or written vignettes are more representative of real-world behavior. Therefore, there is a clear need to assess the intention-behavior gap as a function of methodology, from vignette medium to how an outcome variable is assessed. To expand on this argument, future researchers should have participants first indicate their behavior in a written vignette or VR. Similar to the methodology of Exum and Bouffard (2010), participants should then be given the opportunity to carry out that behavior in real life. Any discrepancy between methods and real-world behavior would be considered the intention-behavior gap and would help determine if video, VR, or written vignettes better represent real-world behavior.

[98]Of the participants that indicate they would *not* commit a crime, none did, indicating 100% accuracy of null cases.

Optimistically, if the same conclusions are consistently drawn between methodologies, then the problem is less worrisome and methodology becomes more of a choice. For example, researchers may choose to use VR when they wish to have a greater control or an interactive element.

Serial Mediation. Neither in Chapters Four nor Five did the results observe the serial mediation found in previous research (Van Gelder et al., 2019). However, in both chapters being in the video or VR condition was significantly positively related to subjective presence. Additionally, in Chapter Four, presence was significantly positively related to state anger, which in turn was significantly positively related to criminal behavior. Consequently, this led to a significant positive indirect effect from being in the VR condition to state anger. Moreover, presence had a significant positive indirect effect on criminal behavior (mediated by state anger).

As indicated in Chapters Four and Five, a higher level of subjective presence is suggested to relate to better estimations of real-world behavior, and therefore reduce the intention-behavior gap (Bailenson, 2018; Ticknor, 2018; Van Gelder et al., 2014, 2019). In other words, "By shutting off real-world input, VR replaces real sense perceptions by those displayed in the VR goggles and therefore substitutes real-world visual input with the input from the virtual environment" (van Gelder et al., 2019, p. 456), and may better represent real-world behavior than the traditional vignette approach (Van Gelder et al., 2014, 2019). Since experiencing or watching the vignette in Chapters Four and Five had a positive relationship with presence, but only being in the VR condition had significant indirect effects on state affect, this suggests that that VR offers something above and beyond a simple video displayed on a computer screen. That is, while VR and videos may elicit similar levels of presence, how this presence will influence key mediators (i.e., state anger) may differ.

Regardless, due to COVID-19 interruption, this research was unable to gather the required sample size to achieve satisfactory power for serial mediation analyses. Furthermore, the COVID-19 interruption required the VR module to be converted to a standard video format. As such, the results cannot conclusively support or refute the notion of how VR may affect criminal behavior, and if this relationship is serially mediated by presence and state anger, respectively. Future researchers should examine how using fully immersive HMD differs from a simple video on a computer screen. For example, using a simple between-groups design in

which participants are either presented a vignette in written, video, or fully immersive VR format, researchers may assess if participants differ in regard to presence, realism, state anger, and criminal behavior. Researchers may then examine if the former three mediate the condition a participant was in and criminal behavior. It may be observed that while being in VR or viewing a video both increase presence, only VR allows for presence to elicit more state anger and indirectly increases criminal intentions.

Open- vs Close-ended Questions

In regard to what factors people naturally recall (e.g., Exum & Bouffard, 2010; Schwarz & Hippler, 1990; Schwarz & Oyserman, 2001), a portion of the factors fit within the existing framework but the majority of factors did not. For example, affect and dispositions were regularly noted by participants for influencing their behavior. Such concepts speak to the importance of aligning proximal theories with dual-process framework as well as integrating the distal and proximal perspectives. Moreover, a number of factors given by participants have been highlighted in qualitative research examining bar fights amongst males (e.g., Archer et al., 1995; Copes et al., 2013; Graham & Wells, 2003; Hochstetler et al., 2014).

In regard to their association with criminal behavior, factors that did not fit within the existing framework were better predictors of criminal behavior than the factors that did. Additionally, the way a vignette was presented did not modify this association. Going forward, researchers need to ensure that regardless of how they present a vignette, they have measures capable of accurately capturing the factors that actually influence participants' decision-making and behavior.

As indicated by the ability to situate a number of themes within the literature surrounding bar fights amongst males but not within the existing framework provided by Bouffard (2002), the results of the open-ended questions may be highly contextualized and specific. The framework provided by Bouffard (2002) was derived from studies assessing sexual assault and drunk driving. While a number of factors were purposefully kept broad to be applicable to variety of scenarios (e.g., situational costs), there are undoubtedly factors that will always be unique to the crime at hand. As such, had the vignettes used in this thesis also examined drunk driving or sexual assault, a greater adherence to the existing categories may have been observed. Additionally, future research examining vignettes other than drunk

driving, sexual assault, or bar fights and using either the existing framework (Bouffard, 2002) or the framework provided here, may also find less adherence.

Finally, it would be remiss to not highlight several factors surrounding the use of VR as a research tool that future researchers may wish to consider before enacting a study.[99] Although technological advancements have significantly reduced the likelihood of participants becoming ill from using VR (i.e., "cybersickness"), physical discomfort is still a possibility. In testing the VR stimulus used in Chapter Four, over time (approximately 30 minutes) the Head Mounted Display (HMD) became uncomfortable.[100] Moreover, if participants wear glasses, this may increase this discomfort or altogether prevent them from participating.[101] Discomfort from the HMD or improper fitting of the HMD (e.g., due to participants wearing glasses) may reduce a participants ability to suspend disbelief and overall presence. Therefore, future researchers should proceed with caution if their stimulus lasted longer than 20 minutes and should prepare to accommodate participants with glasses (e.g., the Oculus Rift has a larger HMD than the HTC Vive, and therefore may better fit for participants with glasses).

Regarding the VR stimulus itself, researchers must consider what type content participants are subjected to. Not everything needs to be made into a VR stimulus. If behaviors or situations are relatively measurable through existing valid methods they do not need to be placed within VR, and doing so may waste valuable resources. More importantly, VR is a great tool for measuring things that are difficult to assess in the real world. However, this creates an ethical problem in which some difficult to observe behaviors can reasonably, and more importantly ethically, be created in VR while some behaviors should not be (Madary & Metzinger, 2016). For example, few would object to a study design involving support for green policies and participants viewing real-world green spaces in VR that would be impossible to achieve in the real world (e.g., taking participants to the middle of a rain forest). Furthermore, evidenced by the study presented in Chapter Four and previous research (e.g., Van Gelder et al., 2019; Van Sintemaartensdijk et al., 2020), few object to studying certain criminal behaviors in VR. However, several would undoubtedly object to a study design interested in understanding individual differences in relation to willingness to execute or torture an avatar

[99] There are also several factors that should be considered for VR use for personal or commercial purposes (e.g., Madary & Metzinger, 2016); however, for the purpose of this thesis I only discuss factors concerning researchers.
[100] As a reminder, the stimulus in chapter four lasted less than three minutes, well below the time point in which I personally felt discomfort.
[101] It should be noted that this did not occur in the study presented in Chapter Four, but is a simple example.

or willingness to carry out a form of terrorism. Therefore, researchers should carefully consider: 1) what type of VR content they create 2) if it is ethical to expose participants to such content and 3) how exposure to certain situations may have longer, unforeseen consequences for participants (Madary & Metzinger, 2016). I suggest the rule of thumb, if the researcher would not be willing to expose themselves or a loved one to that stimulus, they cannot reasonable ask participants to do so.

In summary, the results here indicate that presence follows a linear pattern between methodologies with VR promoting the greatest subjective presence, videos promoting the second greatest, and written vignettes promoting the least. Depending on the primary aim of research, videos may serve as a viable alternative to VR given a time or financial constraint. However, VR may offer unique contributions in regard to how it elicits state emotions. Nonetheless, there needs to be considerable attention drawn to assessing which methodology (VR, video, written, or others not discussed here) best represents real-world behavior in relation to the possibility of drawing different conclusions from similar methodologies. The open-ended questions revealed a number of factors that influence behavior that are not routinely examined in conjecture with one another. Moreover, the factors that are not typically examined appear to be better predictors of criminal behavior. Additionally, researchers need to consider several factors before using VR in the laboratory.

Practical Implications

Throughout this thesis I have highlighted several key theoretical and methodological findings; however, it is equally important to situate these findings within the real world for policy makers and stakeholders. As indicated in the Discussion of Chapter Three, in moments when self-control is low, traditional deterrents such as the likelihood of getting arrested are less influential in reducing criminal behavior. Moreover, throughout this thesis I have illustrated that intuitive decision-making factors such as emotions, norms, and heuristics influence criminal decision-making. Recent research has highlighted that successful deterrence does not have to occur by changing the *objective* likelihood of the costs associated with criminal behavior, but can occur by changing the *perceived* likelihood of such costs through a variety of mechanisms, notably heuristics and emotions (Pickett, 2018). That is, by understanding how heuristics and emotions influence decision-making, policy makers may leverage these insights to reduce criminal behavior (i.e., choice architecture; Pogarsky & Herman, 2019).

This proposition aligns with a number of preventative policies such as hot-spot policing (Ratcliffe et al., 2011) and other research that shows that the mere presence of an enforcer can deter criminal behavior (Van Sintemaartensdijk et al., 2020). Such a policy could be considered an availability or saliency nudge (e.g., Thaler & Sunstein, 2009) as well as using surveillance cues to increase reputational concerns (e.g., Dear et al., 2019).[102] This may also be considered an affect heuristic in which affect-laden information is used to guide decision-making (e.g., Pogarsky et al., 2017; Pogarsky & Herman, 2019; Slovic et al., 2004). Such nudges have been successful in a variety of domains (for a summary see: Battaglio Jr et al., 2019; and Papies, 2017) as well as crime specific contexts (e.g., Ratcliffe et al., 2011). For example, by simply placing a life-sized cardboard cutout of a police officer in area known for bike thefts, local law enforcement was able to reduce bike thefts by 67% (National Public Radio, 2013). Thus, increasing police officer presence, or in the case of the cardboard cutout increasing the *perceived* police officer presence, may make the possibility of detection more salient and apparent in a person's mind and elicit the negative emotions surrounding arrest and detection, reducing overall criminal behavior (e.g., Roche et al., 2019)

However, unlike the current hot-spot policing tactics described above that focus on specific geographic locations (usually areas with high crime rates), I suggest focusing increasing police presence at certain moments in time. This should not be seen as an opposition to current hot-spot policing strategies, as there will undoubtedly be overlap.[103] Instead, this should be used as a modification or addition to the existing hot-spot policing tactics. By increasing police presence in times when state self-control is low we may more effectively reduce criminal behavior and potentially reduce the potential ethical and legitimacy concerns around geographic hot-spot policing (e.g., Gibson et al., 2017; Ratcliffe et al., 2015; Rinehart Kochel, 2010).

In addition to preventative implications, this thesis holds interesting implications for reactive policies, namely in regard to assessment and rehabilitation. One of the primary methods for assessing a known offenders risk of recidivating is the Level of Service Inventory-

[102]Such a nudge could also be considered an "upstream" (i.e., government driven) nudge.
[103]For example, bars are a geographic location that may promote criminal behavior; however, bars after a local sporting event may also be a moment in time when self-control is low and people may be less influenced by the risk associated with crime.

Revised (LSI-R; Andrews et al., 2008). Additionally, the LSI-R determines what factors an offender needs treated (Needs) in order to desist from offending. How practitioners (e.g., service providers such as probation officers) meet and treat these Needs is labeled "responsivity". A major portion of responsivity are factors of the offender that may modify any treatment provided. Although noting some major practical factors (e.g., how the lack of transportation may result in missed probation check-ins), the LSI-R is severely lacking in detail and not as empirically backed as the rest of its assessment (Bonta & Andrews, 2016). Best stated:

> The assessment of responsivity factors is certainly not exhaustive in the LS/CMI [LSI-R], nor is it highly detailed. It covers only some of the major responsivity factors, and correctional staff is encouraged to explore other potential responsivity variables.
>
> (Bonta & Andrews, 2016, p. 201)

As demonstrated throughout this thesis, individuals differ in regard to how they make decisions. Best highlighted by the responses to the open-ended questions in Chapter Five, people will differ in regard to the consideration of the costs and benefits of both law-abiding and criminal behavior. As discussed above, while similar, it would be an error to treat the mirrored-dichotomy of the costs of committing a crime versus the benefit of not committing a crime as the same thing (e.g., Cacioppo & Berntson, 1994; Fredrickson, 2001; Kahneman & Tversky, 1979; Kühberger, 1998; Pittinsky et al., 2011; Ruggeri et al., 2020). A misalignment between what factors practitioners highlight (e.g., the costs of a committing a crime) and what factors an offender is naturally influenced by (e.g., the costs of not committing a crime) may minimize effectiveness. For example, a practitioner may only mention that failure to comply with probation will result in a reconviction (e.g., a cost of a criminal behavior). However, depending on how the offender views the situation and what they are naturally driven by, a better message may be that if they comply with probation they will not be reconvicted (e.g., a benefit of not committing a crime).

While some may argue that such a small detail in phrasing is negligible, there is a large amount of literature showing that it indeed has an effect in a wide range of domains (e.g., Kühberger, 1998; Ruggeri et al., 2020; Tversky & Kahneman, 1981). Any effect in regard to reducing criminal behavior at little to no cost is worth attempting and examining systemically. Additionally, in the context of reducing recidivism informal factors such as practitioner showing up for an appointment on time or returning a phone call to an offender influence such

key outcomes (Cherry, 2010; Trotter, 2004). By incorporating an element to the LSI-R that would assess whether people are driven by an approach or avoidance factors (e.g., Elliot & Thrash, 2002), practitioners may better understand what factors drive an offender's decision-making and tailor their daily interactions, treatment, and overall messages to maximize effectiveness in reducing recidivism.

Limitations

Although extreme care has been taken to be transparent throughout this thesis by not overstating or overgeneralizing the findings and specific limitations have been noted at the end of each chapter, there are still limitations worth highlighting. It should be noted that in all of the models presented in this thesis, the highest R^2 was approximately 0.75. This indicates that there are a number of factors that could be included to improve the explanatory power of any of the predictor variables discussed. Additionally, the fact that this thesis relied on student samples for a portion of Chapter Four as well as samples from crowd sourcing populations needs to be considered. Specifically, although samples drawn from crowd sourcing platforms like Prolific Academic have their merits compared to other platforms such as Amazon Mechanical Turk (Peer et al., 2017), they, along with student populations, are still mainly derived from Western, Educated, Industrialized, Rich, and Democratic nations (WEIRD; Henrich et al., 2010). In addition to WEIRD populations, researchers have also noted that the methodology chosen by researchers can be WEIRD (Baumard & Sperber, 2010). That is, participants may interpret or inject their own meaning to a task presented to them completely different from that which the research intended, due to cultural differences. This tendency is heightened when the experimental procedure is artificial and not representing real-world behavior (Baumard & Sperber, 2010).

For example, what constitutes a crime will not only differ between populations but over time as well. Criminal behaviors may be described as *mala in se*, roughly meaning wrong because they are, or morally wrong, such as murder and theft. Conversely, crimes that are *mala prohibita*, are wrong not because they are immoral, but are illegal because they violate a statue or law put into place for the benefit of the public (Burke, 2014). Thus, as with most constructs, depending on how crime is operationalized, researchers may find different results than the ones here.

Regardless of whether it is differences in the interpretation of task or true differences in the underlying psychology of a participant (or both), it is possible that these results of this thesis could differ in a non-WEIRD population and/or differ in the same population at a different point in time with a varying definition of crime. Thus, to develop the most comprehensive understanding of criminal behavior possible, researchers should continue to use methodology that better represents real-world behavior and seek out non-WEIRD, ecologically valid samples, and the interaction of the two (i.e., offenders in non-WEIRD populations).

In an effort to increase the robustness of the results of this thesis I have used a variety of methods to assess criminal behavior such as, self-reported previous criminal behavior (Chapter Two), written vignettes (Chapters Three, Four, and Five), VR (Chapter Four), and videos (Chapter Five). Although the use of methods such as vignettes, self-reported criminal behavior, VR, and videos allow for more controlled experimental research with a high number of participants increasing statistical power and the ability to draw conclusions – the behaviors are not real-world and therefore the results may not generalize to real-world behavior. While the novel methodologies I have used in this thesis may better approximate real-world behavior and increase researchers certainty in their results, to further increase ecological validity these findings should be replicated using real-world criminal behavior and/or samples of known offenders.

However, to measure real-world criminal behavior researchers must consider several trade-offs. Perhaps most prominently are the ethical considerations surrounding creating an experiment in which an individual could commit an *actual* crime. To do this, researchers would have to create a paradigm in which a participant believes they have the opportunity to commit a crime yet simultaneously ensure ethical boards (e.g. Institutional Review Boards) that no crime would occur (Bouffard & Niebuhr, 2017; Exum & Bouffard, 2010). Although difficult, researchers have attempted to bridge the gap from hypothetical to real-world behavior while maintaining experimental capabilities (e.g., Mazar et al., 2008; Nagin & Pogarsky, 2003; Van Gelder et al., 2013). However, for clear ethical reasons such attempts often measure minor anti-social or deviant behavior (e.g., cheating on a test and lying). As with the discussion in Chapter Three regarding the outcome variables used in the ego-depletion literature (e.g., loud blasts of white noise and negative reviews), such anti-social behavior is not inherently criminal and also may not generalize well to actual or more serious forms of criminal behavior. Thus, while researchers may retain all the benefits of using vignettes (e.g., ability to use experimental

manipulations and to gather psycho-social data), laboratory assessments of criminal behavior are ethically limited in examining certain types of crime.

Real-world observational research is another methodology used to understand crime and criminal behavior (for a thorough review see: Lindegaard & Copes, 2017). Such a methodology increases the ecological validity of criminal behavior (i.e., researchers can observe if an actual crime did or not did not occur) and allows for the examination of various crime types ranging from minor to serious. However, there are number of limitations of such a methodology. For example, passive researchers that observe real-world behavior may be biased in their coding, may bias real-world behavior by being present, or otherwise miss key details due to simple human error (Philpot et al., 2019). Additionally, depending on the level of involvement (e.g., covert versus full participation), researchers may be limited in the data they can gather regarding the individual(s) themselves (e.g., differences in trait self-control or morality) as well as their decision-making process (e.g., did they think about the risk associated with a crime).

Similarly, researchers have also begun to use video observational research methodologies, such as examining CCTV footage of an area where a crime has occurred. While this may reduce coding error due to missing in-the-moment details (e.g., researchers can replay the video over and over), it comes with its own set of limitations including: video quality, sampling biases of who is on camera and what type of crime is visible, the lack of audio in most cases, and as with in-person observational research, the lack of psycho-social data (Lindegaard & Bernasco, 2018). Therefore, although observational research increase the ecological validity and has the ability to observe more serious crimes, unlike vignette research or laboratory procedures, they are often limited in ability to collect psycho-social data and draw casual links.

To summarize, while careful consideration has been taken throughout this thesis and chapter specific limitations have been noted throughout, this research is limited because it relies on a WERID population and does not measure real-world criminal behavior.[104] Nonetheless, by demonstrating consistent results through the use of a variety of methodologies, this thesis

[104]Although it could be argued that the self-reported criminal behavior in Chapter Two is real-world, this method comes with other limitations (see: Chapter Two Discussion).

acts as a well-founded springboard for future researchers to examine similar models in more ecologically valid samples as well as using more ecologically valid methods.

Concluding Remarks

In this doctoral thesis I have contributed to the criminal decision-making literature both theoretically and methodologically. In Chapter One I provided a critical overview and comparison of psychological and criminological concepts that contribute to modeling criminal decision-making. In doing so I demonstrated the need for the traditional proximal perspective to include factors such as emotions and intuition to accurately model human decision-making. In Chapters Two and Three I demonstrated that factors such as emotions, heuristics, and norms associate with criminal decision-making and hold stronger associations compared to the traditional examined risk perception. Moreover, in specific circumstances, such as when state self-control is low, such factors may hold the only association.

As the assessment of criminal behavior has always been met with methodological limitations, primarily regarding ecological validity, in Chapters Four and Five I designed novel paradigms to determine how advancing technologies such as VR and videos may address such limitations. It was found that both videos as well as VR increase the subjective presence of participant experiences' and therefore may better represent real-world behavior. Additionally, using open-ended, rather than the traditionally close-ended questions, I further showed that factors such as emotions, heuristics, and norms influence decision-making alongside dispositions and traditional proximal factors.

Finally, in this chapter I have synthesized the findings of this thesis to detail the major take-aways alongside the emerging literature within the field of criminal decision-making. I have also highlighted areas that act as catalysts for future researchers to continually improve the methodology used to assess criminal behavior. In conclusion, throughout this doctoral thesis I have provided critical support to the notion of: 1) revising the proximal perspective to align with dual process decision-making models by including factors such as emotions and heuristics, 2) combining the distal alongside the proximal perspective to create a more cohesive model, and 3) improving methodology to create more valid test of criminal decision-making that may not only better reflect real-world behavior, but also better incite the factors that naturally influence real-world behavior.

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Appendix A – Advertisements

Advertisement 1 – Chapter Two

Title: Questionnaire about attitudes, beliefs, decision-making, and behavior.

Study description: We would like to learn more about how people's attitudes and beliefs may relate to their decision-making and behaviors. In this study, you will be asked if you agree with variety of statements, how frequently you have done various behaviors in the past year, and how well some descriptions apply to you.

This study will take about 10 to 15 minutes. In return for your participation, you will receive £1.20 upon completion of the survey.

Your responses to this survey are completely anonymous. There are no right or wrong answers, so feel free to share your opinions.

Thank you for your interest and participation!

Advertisement 2 - Chapter Three

Title: Questionnaire about attitudes, decision-making, and behavior in hypothetical decisions.

Study description: We would like to learn more about how people's attitudes and beliefs may relate to their decision-making and behaviors. In this study, you will be asked how well some descriptions apply to you and how you may behave in hypothetical scenarios.

This study will take 10 – 20 minutes (max). In return for your participation, you will receive £1.25 upon completion of the survey.

Your responses to this survey are completely anonymous. There are no right or wrong answers, so feel free to share your opinions.

Thank you for your interest and participation!

Advertisement 3 – Chapter Four, SONA Information

Using Virtual Reality to study behavior and decision-making

Study Name: Using virtual Reality to study behavior and decision-making

Study Type: Standard (lab) study – this is a standard lab study. To participate, sign up, and go to the specified location at the chosen time.

Pay: £8.00

Duration: 40 minutes

Abstract: The purpose of this study is to better understand how people's attitudes or beliefs may relate to their decision-making and behavior using virtual reality.

Description: In this study you will be asked your thoughts and opinions on a variety of matters, how well descriptions apply to you, and what you would do in a hypothetical scenario. For the hypothetical scenario you will be asked to interact in a virtual reality environment using a VR headset that will feature a social dilemma. The expected time commitment for the entire study is approximately 40 minutes (5 - 10 minutes of immersion). After the VR experience you will be asked some follow up questions regarding the dilemma. There are no right or wrong answers in this study. You will receive £8.00 for your participation by successfully completing this study. Please contact William McClanahan if you have any question [redacted].

Due to the nature of the VR equipment, participants prone to motion-sickness should not apply.

Eligibility Requirements: 18 years of age or older, English Speaking, Self-identify as a Man, Bi- or Hetero-sexual.

Website: N/A

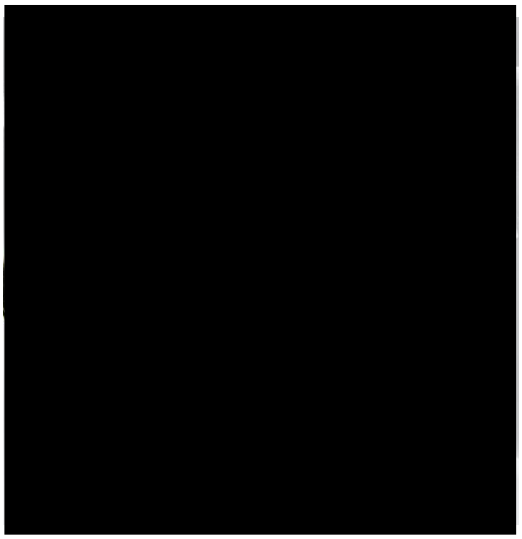
Researcher: William McClanahan

Principal Investigator: Dr. Sander van der Linden

Advertisement Four – Chapter Four, Flyer

UNIVERSITY OF CAMBRIDGE
Department of Psychology

Cambridge Social Decision-Making Lab
Principal Investigator: Dr. Sander van der Linden
Old Cavendish Lab, Free School Lane, University of Cambridge
E-mail: [redacted]
Tel: [redacted]



Participants needed for Virtual Reality Study!

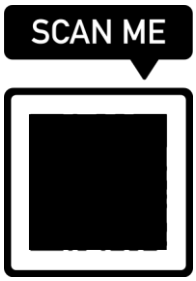
Study Title: Using Virtual Reality to study behavior and decision-making

We are now recruiting for participation in a virtual reality study. The study involves a survey and a 5 to 10-minute virtual reality immersion where you will be presented with a social dilemma and asked to make choices. The whole procedure will take about 40 minutes to complete. During the procedure, you will be asked to wear a VR headset with audio and navigate a virtual reality environment in a psychology testing room. In this study you will also be asked your thoughts and opinions on a variety of matters, how well descriptions apply to you, and what you would do in a hypothetical scenario. After the VR experience you will be asked some follow up questions regarding the dilemma. There are no right or wrong answers in this study. You will receive **£8** for your participation by successfully completing this study.

Due to the nature of the VR equipment and module, participants must:

1) Not be prone to motion-sickness
2) 18 years of age or older
3) English-speaking
4) Self-identify as a Man
5) Bi – or Hetero-sexual

To sign up, please scan the QR Code with any smartphone camera and enter your email on the form and the lead researcher will contact you to set up an appointment – or email the lead research Patrick at [redacted]!



Or if you have a SONA account sign up directly at:
https://cam.sona-systems.com/default.aspx?p_return_experiment_id=235.

Please note that timeslots will be added regularly so do check back if the timeslots are full the first go around!

Advertisement 5 – Chapter Four, Prolific Academic Advertisement

Using Virtual Reality to study behavior and decision-making

Title: Survey about attitudes, decision-making, and behavior in hypothetical decisions.

Study description: We would like to learn more about how people's attitudes and beliefs may relate to their decision-making and behaviors. In this study, you will be asked how well some descriptions apply to you and how you may behave in a hypothetical scenario.

This study will take about 10 – 20 minutes (max). In return for your participation, you will receive £1.25 upon completion of the survey.

Your responses to this survey are completely anonymous. There are no right or wrong answers, so feel free to share your opinions.

Thank you for your interest and participation!

Advertisement 6 – Chapter Five

Title: Decision-making and hypothetical scenarios

Abstract: We would like to learn more about how people's attitudes and beliefs may relate to their decision-making and behaviors. In this study, you will be asked how well some descriptions apply to you and how you may behave in a hypothetical scenario.

Please note – to successfully complete this study and receive payment you will be asked to free write for approximately four minutes. Additionally, you may be asked to watch a video with audio.

This study will take you about 8 – 12 minutes. In return for your participation you will receive £1.00.

Your response to this survey are completely anonymous. There is no right or wrong answers, so feel free to share your opinion.

Thank you for your interest and participation!

Exclusion criteria:

1) 18 years of age or older
2) English-speaking
3) Identify as a Man
4) Bi- or hetero-sexual
5) Desktop only
6) Normal or Corrected-to-Normal Hearing

Appendix B – Consent and Debrief Forms

Consent Form 1 – Chapter Two

Welcome to the research study!

We would like to invite you to participate in our research study. Before you decide to participate, we want to make sure you understand why the research is being done, and what is required for you to participate. At any point during your participation if you have questions or concerns, please feel free to contact the principal researcher, William McClanahan, at [redcated].

The purpose of this study is to better understand how people's attitudes or beliefs may relate to their decision-making and behavior. To achieve this, we are asking adults like yourself to participate in this study.

In this study you will be asked your thoughts and opinions on a variety of matters, and if you have ever exhibited certain behaviors. There are no right or wrong answers in this study. The study should take you around 10-15 minutes to complete, and you will receiv5e 1.10 GBP for your participation.

The results and data collected from this study may be shared with other researchers, used in publications, and/or for academic assignments. However, it will remain anonymous and will not include any identifiable information and all records will be stored on password protected computers. Your participation in this research is voluntary. You have the right to withdraw at any point during the study, for any reason, and without any prejudice, and may do so by simply closing the browser.

There are no other benefits to this study other than the specified compensation.

While there are no foreseeable risks to participating in this study, some questions asked may be about personal or sensitive matters and could be consider difficult to answer. If you at any point feel uncomfortable answering these questions, you may stop participating. The project has ethical approval from the Psychology Research Ethics Committee of the University of Cambridge, PRE.2018.054.

By clicking the, " I consent, begin the study" button below, you acknowledge that your participation in the study is voluntary, you are 18 years of age, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason. Please note that this survey will be best displayed on a laptop or desktop computer. Some features may be less compatible for use on a mobile device.

o I consent, begin the study
o I do not consent, I do not wish to participate

Debrief Form 1 – Chapter Two

Thank you for your participation. Through this study, we hope to better understand how variety of factors such as empathy, self-control, and one's opinions associate with numerous behaviors. The data and results of this study will remain anonymous and may be used for academic purposes (e.g., thesis paper or publications). If you have any questions, comments, or concerns, please feel free to email William McClanahan at [redacted] or Dr. Sander van der Linden at [redacted]. This study has been approved by the Institutional Review Board at the University of Cambridge. Application No: PRE.2018.054. If you have any questions regarding ethical approval, please find their website here, or email Ethics Coordinator, Cheryl Torbett at, [redacted].

Thank you for your time, please click submit to finish the survey.

Consent Form 2 - Chapter Three

Welcome to the research study!

We would like to invite you to participate in our research study. Before you decide to participate, we want to make sure you understand why the research is being done, and what is required for you to participate.

The purpose of this study is to better understand how people's attitudes or beliefs may relate to their decision-making and behavior. To achieve this, we are asking adults like yourself to participate in this study.

In this study you will be asked your thoughts and opinions on a variety of matters, how well descriptions apply to you, and what you would do in some hypothetical scenarios. There are no right or wrong answers in this study. The study should take you 10 - 20 minutes (max) to complete, and you will receive £1.25 for your participation by successfully completing the survey.

Benefit and Risk:
The only benefit for this study is the stated financial compensation, which requires successful completion of the survey. However, you should feel no pressure to continue the survey and are welcome to stop at any point by simply closing your browser. While there are no foreseeable risks to participating in this study, some questions asked may be about personal or sensitive matters and could be consider difficult to answer. If you at any point feel uncomfortable answering these questions, you may stop participating by simply closing your browser. The project has ethical approval from the Psychology Research Ethics Committee of the University of Cambridge.

Confidentiality:
Your responses in this study will be kept private, and we will not include any information that will make it possible to identify you in any report we might publish. Research records will be stored securely on password-protected computers. The results and data collected in this study may be shared with other researchers.

The only potential identifiable information we request is your Prolific ID for data quality and payment processing purposes. Once both have been established your Prolific ID will be discarded.

Additionally, while we do not request other identifiable information, one free response question allows you to input any information you wish. For such questions, we request that you refrain from including any identifiable information.

GDPR Statement:
We will be using any personal information you give us in order to undertake this study and the University of Cambridge will act as the data controller for this purpose. The legal basis for using your personal information is to carry out a task (i.e., academic research) in the public interest. We will keep the information that you provide us with for as long as necessary for the study. Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already

obtained. To safeguard your rights, we will use the minimum personally-identifiable information possible. For further general information about the University of Cambridge's use of your personal data as a participant in a research study, please click here.

We wish to re-emphasize that we will not ask you for any information that could personally identify you and will not keep your Prolific ID with the research data once quality has been assured and payment processed.

Who to contact with questions:
If at any point in time you have questions or concerns please contact the study contact, William McClanahan, [redacted].

By clicking the, "I consent, begin the study" button below, you indicate you understand the information presented to you, acknowledge that your participation in the study is voluntary, you are 18 years of age, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason.

Please note that this survey will be best displayed on a laptop or desktop computer. Some features may be less compatible for use on a mobile device.

- ○ I consent, begin the study
- ○ I do not consent, I do not wish to participate

Debrief Form 2 – Chapter Three

Thank you for your participation. This is the end of the study. Below you will find more information about this study.

Through this study, we hope to better understand how factors such as self-control, social information, perceived risk, and positive and negative emotions influence decision-making in hypothetical scenarios involving illegal behavior. In order to do this, we randomly assigned participants to partake in a writing task that either did or did not require a great deal of self-control. All participants were then presented the same four hypothetical scenarios and asked the same questions involving what they would do in that scenario, if they thought it was risky, how it made them feel, and if they thought society as a whole believes that behavior to be acceptable. Based on which writing task participants were randomly assigned to, we hope to examine what factors such as emotions, perceived riskiness, and social information best predict how they chose to behave in each scenario.

If you wish to have your data removed from analysis you may do so by contacting the primary researcher, William McClanahan, at [redacted]. If you have any questions, comments, or concerns, please feel free to email William McClanahan at [redacted] or Dr. Sander van der Linden at [redacted]. This study has been approved by the Psychology Research Ethics Committee at the University of Cambridge. If you have any questions regarding ethical approval, please find their website here.

Consent Form 3 – VR, Chapter Four

Using Virtual Reality to study behavior and decision-making

UNIVERSITY OF CAMBRIDGE
Department of Psychology

Cambridge Social Decision-Making Lab
Principal Investigator: Dr Sander van der Linden
Old Cavendish Lab, Free School Lane, University of Cambridge
E-mail:[redacted]
Tel: [redacted]

Participant Information Sheet

Using Virtual Reality to study behavior and decision-making

Welcome to the research study!

We would like to invite you to participate in our research study. Before you decide to participate we want to make sure you understand why the research is being done, and what is required for you to participate.

The purpose of this study is to better understand how people's attitudes or beliefs may relate to their decision-making and behavior. To achieve this, we are asking adults like yourself to participate in this study.

In this study you will be asked your thoughts and opinions on a variety of matters, how well descriptions apply to you, and what you would do in a hypothetical scenario. For the hypothetical scenario you will be asked to interact in a virtual reality environment using a VR headset that will feature a social dilemma. The expected time commitment for the entire study is approximately 40 minutes (5 - 10 minutes of immersion). After the VR experience you will be asked some follow up questions regarding the dilemma. There are no right or wrong answers in this study. You will receive £8 for your participation by successfully completing this study.

To participate in this study you must be:

1) 18 years of age or older

2) English Speaking

3) Self-identify as a Man

4) Bi- or hetero-sexual

Benefit and Risk:
The only benefit for this study is the stated financial compensation, which requires successful completion of the study. However, you should feel no pressure to continue the study and are welcome to stop at any point by simply alerting the researcher. It is important to note that although unlikely, it is possible that you may experience some mild dizziness or nausea during or immediately after the VR immersion. If, at any point during the procedure, you feel unwell

or uncomfortable please signal the experimenter and the VR procedure will be stopped immediately. You may discontinue your participation at any time. Some of the things you are exposed to might make you feel positive or negative emotions, but no more than what you would normally encounter while reading the news or talking to other people. If you feel uncomfortable, you may stop participating at any time. The project has been reviewed by the Psychology Research Ethics Committee of the University of Cambridge PRE.2019.061

Confidentiality:
Your responses in this study will be kept private, and we will not include any information that will make it possible to identify you in any report we might publish. The results and data collected in this study may be shared with other researchers. Research records will be stored securely on password-protected computers.

Additionally, while we do not request other identifiable information, one free response question allows you to input any information you wish. For such questions, we request that you refrain from including any identifiable information.

GDPR Statement:
Your responses will be anonymized and are not linked to your identity. We will be using any personal information you give us in order to undertake this study and the University of Cambridge will act as the data controller for this purpose. The legal basis for using your personal information is to carry out a task (i.e., academic research) in the public interest. We will keep the information that you provide us with for as long as necessary for the study. Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally-identifiable information possible. For further general information about the University of Cambridge's use of your personal data as a participant in a research study, please click here.

We wish to re-emphasize that we will not ask you for any information that could personally identify you.

Who to contact with questions:

If at any point in time you have questions or concerns please contact the study contact, William McClanahan, [redacted].

Consent to take part in the study, "Using Virtual Reality to study behavior and decision-making".

To consent and begin the study, please tick the boxes below and click the arrow to continue.

	Yes	No
1. I confirm that I have read and understood the information sheet for the above study.	☐	☐
2. I have had the opportunity to ask questions and had them answered.	☐	☐

3. I understand that all personal information will remain confidential and that all efforts will be made to ensure I cannot be identified (except as might be required by law). ☐ ☐

4. I understand that data gathered in this study may be stored anonymously and securely, and may be used for future research. ☐ ☐

5. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason. ☐ ☐

6. I confirm that I am at least 18 years of age, English-speaking, Self-identify as a Man, and either Bi- or hetero-sexual. ☐ ☐

7. I agree to take part in this study. ☐ ☐

Debrief Form 3 – VR, Chapter Four

Using Virtual Reality to study behavior and decision-making

Cambridge Social Decision Making Lab
Principal Investigator: Dr Sander van der Linden
Old Cavendish Lab, Free School Lane, University of Cambridge
E-mail: [redacted]
Tel:[redacted]

Thank you for your participation. This is the end of the study. Below you will find more information about this study.

Through this study, we hope to better understand how factors such as impulsivity, perceived risk, perceived realism and presence, and positive and negative emotions influence decision-making in a hypothetical scenario involving a provocation. In order to do this, we randomly assigned participants to participate in a writing task that either did or *did not* require a great deal of restraint and attention. All participants were then presented the same hypothetical scenario and asked the same questions involving what they would do in that scenario, if they thought it was risky, if they thought the scenario was real, and how it made them feel. Based on which writing task participants were randomly assigned to, we hope to examine what factors such as emotions, perceived riskiness, and realism best predict how they chose to behave in the scenario. Additionally, we sought to understand how the use of VR to study decision-making may advance the field. To accomplish this task, other participants completed the exact same study, but read a transcript of the scenario you experienced in the VR immersion.

If you wish to have your data removed from analysis you may do so by contacting the primary researcher, William McClanahan, at [redacted] within one week of completion. If you have any questions, comments, or concerns, please feel free to email William McClanahan at [redacted] or Dr. Sander van der Linden at [redacted]. This study has been approved by the Psychology Research Ethics Committee at the University of Cambridge. Application No: PRE.2019.061. If you have any questions regarding ethical approval, please find their website here.

Consent Form 4 – Written, Chapter Four

Using Virtual Reality to study behavior and decision-making

UNIVERSITY OF CAMBRIDGE
Department of Psychology

Cambridge Social Decision-Making Lab
Principal Investigator: Dr Sander van der Linden
Old Cavendish Lab, Free School Lane, University of Cambridge
E-mail: [redacted]
Tel: [redacted]

Study Title: Survey about attitudes, decision-making, and behavior in hypothetical decisions.

Welcome to the research study!

We would like to invite you to participate in our research study. Before you decide to participate we want to make sure you understand why the research is being done, and what is required for you to participate.

The purpose of this study is to better understand how people's attitudes or beliefs may relate to their decision-making and behavior. To achieve this, we are asking adults like yourself to participate in this study.

In this study you will be asked your thoughts and opinions on a variety of matters, how well descriptions apply to you, and what you would do in a hypothetical scenario. There are no right or wrong answers in this study. The study should take you 10 - 20 minutes (max) to complete, and you will receive £1.25 for your participation by successfully completing the survey.

To participate in this study you must be:
1) 18 years of age or older
2) English Speaking
3) Self-identify as a Mam
4) Bi- or hetero-sexual

Benefit and Risk:
The only benefit for this study is the stated financial compensation, which requires successful completion of the survey. However, you should feel no pressure to continue the survey and are welcome to stop at any point by simply closing your browser. While there are no foreseeable risks to participating in this study, some questions asked may be about personal or sensitive matters and could be consider difficult to answer. If you at any point feel uncomfortable answering these questions, you may stop participating by simply closing your browser. The project has been reviewed by the Psychology Research Ethics Committee of the University of Cambridge PRE.2019.061

Confidentiality:
Your responses in this study will be kept private, and we will not include any information that will make it possible to identify you in any report we might publish. The results and data collected in this study may be shared with other researchers. Research records will be stored securely on password-protected computers.

The only potential identifiable information we request is your Prolific ID for data quality and payment processing purpose. Once both have been established your Prolific ID will be discarded.

Additionally, while we do not request other identifiable information, one free response question allows you to input any information you wish. For such questions, we request that you refrain from including any identifiable information.

GDPR Statement:
We will be using any personal information you give us in order to undertake this study and the University of Cambridge will act as the data controller for this purpose. The legal basis for using your personal information is to carry out a task (i.e., academic research) in the public interest. We will keep the information that you provide us with for as long as necessary for the study. Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally-identifiable information possible. For further general information about the University of Cambridge's use of your personal data as a participant in a research study, please click here.

We wish to re-emphasize that we will not ask you for any information that could personally identify you and will not keep your Prolific ID with the research data once quality has been assured and payment processed.

Who to contact with questions:
If at any point in time you have questions or concerns please contact the study contact, William McClanahan, [redacted].

To consent and begin the study, please tick the boxes below and click the arrow to continue.

Please note that this survey will be best displayed on a laptop or desktop computer. Some features may be less compatible for use on a mobile device.

To consent and begin the study, please tick the boxes below and click the arrow to continue.

	Yes	No
1. I confirm that I have read and understood the information sheet for the above study.	☐	☐
2. I have had the opportunity to ask questions and had them answered.	☐	☐
3. I understand that all personal information will remain confidential and that all efforts will be made to ensure I cannot be identified (except as might be required by law).	☐	☐
4. I understand that data gathered in this study may be stored anonymously and securely, and may be used for future research.	☐	☐
5. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason.	☐	☐

6. I confirm that I am at least 18 years of age, English-speaking, Self-identify as a Man, and either Bi- or hetero-sexual. ☐ ☐

7. I agree to take part in this study. ☐ ☐

Debrief Form 4 – Written, Chapter Four

Using Virtual Reality to study behavior and decision-making

Cambridge Social Decision-Making Lab
Principal Investigator: Dr Sander van der Linden
Old Cavendish Lab, Free School Lane, University of Cambridge
E-mail: [redacted]
Tel: [redacted]

Thank you for your participation. This is the end of the study. Below you will find more information about this study.

Through this study, we hope to better understand how factors such as impulsivity, perceived risk, perceived realism and presence, and positive and negative emotions influence decision-making in a hypothetical scenario involving a provocation. In order to do this, we randomly assigned participants to participate in a writing task that either did or *did not* require a great deal of restraint and attention. All participants were then presented the same hypothetical scenario and asked the same questions involving what they would do in that scenario, if they thought it was risky, if they thought the scenario was real, and how it made them feel. Based on which writing task participants were randomly assigned to, we hope to examine what factors such as emotions, perceived riskiness, and realism best predict how they chose to behave in the scenario. Additionally, we sought to understand how the use of VR to study decision-making may advance the field. To accomplish this task, other participants completed the exact same study, but experienced the scenario that you read in an immersive VR experience.

If you wish to have your data removed from analysis you may do so by contacting the primary researcher, William McClanahan, at [redacted] within one week of completion. If you have any questions, comments, or concerns, please feel free to email William McClanahan at [redacted] or Dr. Sander van der Linden at [redacted]. This study has been approved by the Psychology Research Ethics Committee at the University of Cambridge. Application No: PRE.2019.061. If you have any questions regarding ethical approval, please find their website here.

Consent Form 5 – Chapter Five

Cambridge Social Decision-Making Lab
Principal Investigator: Dr Sander van der Linden
Old Cavendish Lab, Free School Lane, University of Cambridge

Welcome to the research study!

We would like to invite you to participate in our research study. Before you decide to participate we want to make sure you understand why the research is being done, and what is required for you to participate.

The purpose of this study is to better understand decision making in hypothetical scenarios. To achieve this, we are asking adults like yourself to participate in this study.

In this study you will be asked your thoughts and opinions on a variety of matters and what you would do in a hypothetical scenario. There are no right or wrong answers in this study. The study should take you approximately 8 to 12 minutes to complete, and you will receive £1.00 for your participation by successfully completing the survey.

Please note - this survey requires approximately 4 minutes of free writing for payment to occur.

Additionally, you may be asked to watch a video with sound for this study.

To participate in this study you must be:

1) 18 years of age or older
2) English Speaking
3) Self-identify as a Man
4) Bi- or hetero-sexual
5) Normal or Corrected-to-Normal Hearing

Benefit and Risk:
The only benefit for this study is the stated financial compensation, which requires successful completion of the survey. However, you should feel no pressure to continue the survey and are welcome to stop at any point by simply closing your browser. While there are no foreseeable risks to participating in this study, some questions asked may be about personal or sensitive matters and could be consider difficult to answer. If you at any point feel uncomfortable answering these questions, you may stop participating by simply closing your browser. The project has been reviewed by the Psychology Research Ethics Committee of the University of Cambridge: PRE.2020.038

Confidentiality:
Your responses in this study will be kept private, and we will not include any information that will make it possible to identify you in any report we might publish. The results and data collected in this study may be shared with other researchers. Research records will be stored securely on password-protected computers. The only potential identifiable information we request is your Prolific ID for data quality and payment processing purpose. Once both

have been established your Prolific ID will be discarded. Additionally, while we do not request other identifiable information, free response questions allow you to input any information you wish. For such questions, we request that you refrain from including any identifiable information.

General information about how the University uses personal data can be found at: https://www.information-compliance.admin.cam.ac.uk/data-protection/research-participant-data.

GDPR Statement:
We will be using any personal information you give us in order to undertake this study and the University of Cambridge will act as the data controller for this purpose. The legal basis for using your personal information is to carry out a task (i.e., academic research) in the public interest. We will keep the information that you provide us with for as long as necessary for the study. Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally-identifiable information possible. For further general information about the University of Cambridge's use of your personal data as a participant in a research study, please click here.

We wish to re-emphasize that we will not ask you for any information that could personally identify you and will not keep your Prolific ID with the research data once quality has been assured and payment processed.

Who to contact with questions:
If at any point in time you have questions or concerns please contact the study contact, William McClanahan, [redacted].

Please note that this survey must be displayed on a laptop or desktop computer as some features are not compatible for use on a mobile device.

To consent and begin the study, please tick the boxes below and click the arrow to continue.

	Yes	No
1. I confirm that I have read and understood the information sheet for the above study.	☐	☐
2. I have had the opportunity to ask questions and had them answered.	☐	☐
3. I understand that all personal information will remain confidential and that all efforts will be made to ensure I cannot be identified (except as might be required by law).	☐	☐
4. I understand that data gathered in this study may be stored anonymously and securely, and may be used for future research.	☐	☐

5. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason. ☐ ☐

6. I confirm that I am at least 18 years of age, English-speaking, Self-identify as a Man, am either Bi- or hetero-sexual, and have either normal or corrected-to-normal hearing ☐ ☐

7. I confirm that I am participating on either a laptop or desktop computer ☐ ☐

8. I confirm that I understand that to participate in this study I will be required to free write for approximately 4 minutes ☐ ☐

9. I confirm that I understand that I may be asked to watch a video with sound as a portion of this study ☐ ☐

10. I agree to take part in this study. ☐ ☐

Debrief Form 5 – Video, Chapter Five

Cambridge Social Decision-Making Lab
Principal Investigator: Dr Sander van der Linden
Old Cavendish Lab, Free School Lane, University of Cambridge

Thank you for your participation. This is the end of the study. Below you will find more information about this study.

Through this study, we hope to better understand how factors such as the presence and realism influence what factors are considered when making decisions. Half of the participants in this study experienced the same video as you and then were asked to answer the same questions. However, for comparison, the other half of the participants read a transcript of the scenario you experienced. From this research we hope to better understand not only what factors people consider generally when making decisions about behavior, but if this differs based on if they experience it versus read it.

If you wish to have your data removed from analysis you may do so by contacting the primary researcher, William McClanahan, at [redacted] within one week of completion. If you have any questions, comments, or concerns, please feel free to email William McClanahan at [redacted] or Dr. Sander van der Linden at [redacted]. This study has been approved by the Psychology Research Ethics Committee at the University of Cambridge. Application No:PRE.2020.038. If you have any questions regarding ethical approval, please find their website here.

To obtain your completion code please click the next arrow

Debrief Form 6 – Written, Chapter Five

Cambridge Social Decision-Making Lab
Principal Investigator: Dr Sander van der Linden
Old Cavendish Lab, Free School Lane, University of Cambridge

Thank you for your participation. This is the end of the study. Below you will find more information about this study.

Through this study, we hope to better understand how factors such as the presence and realism influence what factors are considered when making decisions. Half of the participants read the same written transcript as you and then were asked to answer the same questions. However, for comparison, the other half of participants experienced the scenario you read as a video. From this research we hope to better understand not only what factors people consider generally when making decisions about behavior, but if this differs based on if they experience it versus read it.

If you wish to have your data removed from analysis you may do so by contacting the primary researcher, William McClanahan, at [redacted] within one week of completion. If you have any questions, comments, or concerns, please feel free to email William McClanahan at [redacted] or Dr. Sander van der Linden at [redacted]. This study has been approved by the Psychology Research Ethics Committee at the University of Cambridge. Application No: PRE.2020.038. If you have any questions regarding ethical approval, please find their website here.

To obtain your completion code please click the next arrow

Appendix C – Questions and Items

Set 1 - Eight-item Brief Self-control Scale (Maloney et al., 2012)
All items were presented on a 1 (Not at all like me) to 5 (Very much like me) Likert-scale.
R – indicates reverse coded

1. I am good at resisting temptation
2. I do certain things that are bad for me, if they are fun R
3. I have a hard time breaking bad habits R
4. Pleasures and fun sometimes keep me from getting work done R
5. I wish I had more self-discipline R
6. Sometimes I can't stop myself from doing something, even if I know it is wrong R
7. People would say I have iron self-discipline
8. I often act without thinking through all the alternatives R

Set 2 - 10-item Decision-making styles scale (Hamilton et al., 2016)
All items were presented on a 1 (Not at all like me) to 5 (Very much like me) Likert-scale.

1. I prefer to gather all the necessary information before committing to a decision
2. When making decisions, I rely mainly on my gut feelings
3. I thoroughly evaluate decision alternatives before making a final choice
4. My initial hunch about decisions is generally what I follow
5. In decision making, I take time to contemplate the pros/cons or risks/benefits of a situation
6. I make decisions based on intuition
7. Investigating the facts is an important part of my decision-making process
8. I rely on my first impressions when making decisions
9. I weigh a number of different factors when making decisions
10. I weight feelings more than analysis in making decisions

Set 3 – Eight-item self-reported criminal behavior adapted from Elliot, Huizinga, & Ageton (1985).
All items were primed with the phrase, "In the past 12 months, how many times have you…" and participants indicated the frequency on a zero (none) to 5 (5 or more times) frequency scale.

1. Purposely damaged or destroyed property that did not belong to you
2. Stolen, or tried to steal, a car, motorcycle, bicycle, or other form of transportation (including "free-riding" on public transportation)
3. Knowingly bought, sold, or tried to buy/sell stolen goods
4. Been involved in a physical fight or shoving match, with another individual or group
5. Sold an illegal substance such as, but not limited to, marijuana, heroin, cocaine, or LSD
6. Have broken into, or tried to break into, a building or vehicle
7. Stolen something (including money)
8. Use an illegal substance such as, but not limited to, marijuana, heroin, heroin, cocaine, or LSD

Set 4 – 12-item Marlowe-Crowne Social Desirability Scale (Reynolds, 1982)
All items were scored on a True (1) False (0) Scale
R – indicates reverse coding

1. It is sometimes hard for me go on with my work if I am not encouraged R
2. I sometimes feel resentful when I don't get my way R
3. On a few occasions, I have given up doing something because I thought too little of my ability R
4. There have been times when I felt like rebelling against authority even though I knew they were right R
5. No matter who I am talking to, I'm always a good listener
6. There have been occasions when I took advantage of someone R
7. I'm always willing to admit when I make a mistake
8. I sometimes try to get even, rather than forgive and forget
9. I am always courteous, even to people who are disagreeable
10. I have never been frustrated when people expressed ideas very different from my own
11. There have been times when I was quite jealous of the good fortunes of others R
12. I am sometimes irritated by people who ask favors of me
13. I have never deliberately said something to hurt someone's feelings

Set 5 – Ego-depletion Manipulation Check
Items were on a 1 (Not at all) to 5 (Very much) Likert-scale.
1. How difficult did you find writing about your recent trip [or in the case of Chapter Four: the color task]?
2. How cognitively demanding did you find writing about your recent trip [or in the case of Chapter Four: the color task]?

Set 6 – Items assessing Criminal Choice, Chapter Three
Items 1 and 2 are on a one (Extremely Unlikely, Extremely Uncertain) to seven (Extremely Likely, Extremely Certain) scale.

1. How likely is it that you would [insert criminal behavior]?
2. How certain are you about your decision to [insert criminal behavior]?
3. On a scale from 0% (I definitely would NOT) to a 100% (I definitely would), how likely is it that you would [insert criminal behavior]?

Set 7 – Negative and Positive Affect (Van Gelder & De Vries, 2014).
Items were on a 1 (Not at all) to 7 (Entirely) Likert-scale.
1. Would this situation make you feel insecure?
2. Would you find the situation frightening?
3. Would you be worried?
4. Would you be nervous?
5. Does this situation evoke negative feelings in general?
6. Would this situation make you feel excited?
7. Would this situation make you feel relief?
8. Would this situation be thrilling?
9. Would this situation make you feel calm?
10. Does this situation evoke overall positive feelings?

Set 8 – Perceived Riskiness (Nagin & Paternoster, 1993; Van Gelder & De Vries, 2014). Items were on a 1 to 7-point Likert-scale.
1. How likely is it that you will be caught if you [insert criminal behavior]?
2. What are the chances you will be found out if you [insert criminal behavior]?
3. How severe do you consider the possible consequences of being caught to be?
4. How annoying do you find the potential negative consequences of being caught for [insert criminal behavior here]?

Set 9 – Perceived Social Consensus
The item was on 0 (No one finds this behavior to be acceptable) – 100% (Most, if not all, find this behavior to be acceptable) sliding scale.
1. What percentage of people do you think find [insert criminal behavior here] to be acceptable?

Set 10 – Aggression Questionnaire Short Form (Buss & Perry, 1992; Bryant & Smith, 2001). All items were primed with the phrase, "Please indicate how well these statements describe you on a 1 (Extremely uncharacteristic of me) to 5 (Extremely characteristic of me) scale"

1. Given enough provocation, I may hit another person
2. There are people who pushed me so far that we came to blows
3. I have threatened people I know
4. I often find myself disagreeing with people
5. I can't help getting into arguments when people disagree with me
6. My friend's say that I'm somewhat argumentative
7. I flare up quickly but get over it quickly
8. Sometimes I fly off the handle for no good reason
9. I have trouble controlling my anger
10. At times I feel I have gotten a raw deal out of life
11. Other people always seem to get the breaks
12. I wonder why sometimes I feel so bitter about things

Set 11 - The Brief State Self-control Capacity Scale (Lindner, Lindner, & Retelsdorf, 2019; Bertrams, Unger und, & Dickhäuser, 2011)**.**
All items were primed with the phrase, "Please indicate how well these statements describe how you currently feel on a 1 (Not at all true) to 7 (Very true) scale. R – indicates reverse coded

1. I feel drained
2. I feel calm and rational R
3. I feel lazy
4. I feel sharp and focused R
5. I feel like my will power is gone

Set 12 – International Positive and Negative Affect Short Form (I-PANAS-SF; Thompson, 2007; Watson, Clark, & Tellegen, 1988).
All items were primed with the phrase, On a scale from 1 (Very slightly or not at all) to 5 (Extremely) please indicate to what extent the following words describe how you feel this way right now, at the present moment.

1. Afraid
2. Active
3. Jittery
4. Attentive
5. Determined
6. Nervous
7. Inspired
8. Ashamed
9. Alert
10. Irritable
11. Proud
12. Enthusiastic
13. Hostile
14. Scared
15. Guilty
16. Strong
17. Upset
18. Excited
19. Distressed
20. Interested

Set 13 – "Bar fight" vignette (Exum, 2002; van Gelder et al., 2019).

You are now going to be presented with a dilemma and will be asked to answer some questions following it.

Note: Some questions may appear similar but are in fact different.

Imagine the following scenario: It's Friday night and you are out with your girlfriend Lisa in Irish Pub Molly Malone's in the city center. You and Lisa, with whom you have been dating for two years now, went to Molly's for food. The food was great and you enjoyed a nice glass of wine with it. After the main course you decide against taking desert or coffee but to head home instead. You walk to the bar to pay. The bartender asks you whether you enjoyed the food while presenting you the bill. You tell him the food was great while paying him and tell him to keep the change. While returning to your table you see a guy in his 20s that you don't know standing close to and talking with Lisa. Walking back to your table you hear him ask for Lisa's phone number. The following dialogue unfolds:

YOU: "What's going on? Are you hitting on my girlfriend?"
GUY: (keeps looking at Lisa) "I don't see a ring on her finger so she can talk to whoever she wants to."
YOU: "Lisa, let's go."
GUY: (to you): "Maybe you should go."
YOU: (louder) "I am not talking to you!"

GUY: (turning towards you): “But I am talking to you.”
YOU: (raised voice) “Shut up!”
GUY: (raised voice) “You shut up!”
YOU: (raised voice and threatening) “And now stop it!”
GUY: (provocative) “Or what . . . ?”

What would you do?

- Just walk away
- Shove the guy
- Hit the guy with a bottle

Set 14 – Likert outcome variables, Chapter Four and Five
Participants were primed with the phrase, on a 1 (Not at all likely) to 7 (Extremely likely) scale, in a similar scenario to the one you just experienced, how likely is it that you would...

1. ...walk away from him
2. ...shove him
3. ...hit him with a bottle

Set 15 – Presence Items (Schubert, Friedmann, & Regenbrecht, 2001)
All items were primed with the phrase:
“Think back to when you were imagining the scenario [for VR participants: “in the VR experience”] and please indicate on a 1 (Strongly disagree) to 5 (Strongly agree) scale how much you agree with the following statements:

1. I had a sense of being in the scenario
2. Somehow I felt that the scenario surrounded me
3. I did not feel present in the scenario
4. I felt present in the scenario
5. I was fully aware of the real world around me while imagining the scenario [for VR participants: “in the VR experience”]
6. I was not aware of the real world around me when imagining the scenario [for VR participants: “in the VR experience”]
7. I still paid attention to the real world around me when imagining the scenario [for VR participants: “in the VR experience”]
8. I was completely captivated by the scenario
9. The scenario seemed imaginary to me
10. I had a sense of acting within the scenario

Set 16 – Realism Items (Van Gelder et al., 2019)
All items were primed with the phrase:
“Considering the situation you just read and imagined [for VR participants: “the VR experience you just had”], please indicate on a 1 (Strongly disagree) to 7 (Strongly agree) scale how much you agree with the following statements:

1. I thought the scenario was fictitious R
2. I found the scenario convincing
3. The scenario was realistic
4. The scenario was clear
5. The scenario struck me as real

6. The scenario was easy to comprehend

Set 17 – Risk Items, Chapter Four (Nagin & Paternoster, 1993; Van Gelder & De Vries, 2012; van Gelder & de Vries, 2014).
All items were primed with the phrase:
"Think back to the moment you made your decision [for VR participants: "made your decision in the VR experience] and indicate on a 1 (Disagree entirely) to 5 (Agree entirely) scale how much you agree with the following statements:

1. The likelihood of negative consequences for an aggressive decisions was very high
2. An aggressive decision would not have any serious consequences
3. There was only a small chance for something bad to happen as a result of an aggressive decision
4. An aggressive decision posed serious consequences

Set 18 – Affect Items (Positive, Negative, and Anger) (Van Gelder et al., 2019)**.**
All items were on a 1 (Not at all) to 7 (Very much) scale and primed with the phrase:
"Did the situation that you just read and imagined [for VR participants: "experienced"] make you feel...

1. ...Insecure
2. ...Frightened
3. ...Worried
4. ...Nervous
5. ...Negative feelings in general
6. ...Excited
7. ...Relief
8. ...Thrilled
9. ...Calm
10. ...Positive feelings in general
11. ...Angry
12. ...Annoyed
13. ...Irritated
14. ...Furious
15. ...Frustrated

Set 19 - Open-ended Questions Assessing Deterrents and Drivers

Drivers: In the space below, please describe some of the thoughts or factors that you believe *lead to the behavior you chose*. These can be positive or negative factors, anything at all is acceptable, but please try to be as specific as possible.

Notes: This page will automatically progress after a set time of two minutes has passed.

Deterrents: In the space below, please describe some of the thoughts or factors that you believe *discouraged you from choosing other potential behaviors*. These can be positive or negative factors, anything at all is acceptable, but please try to be as specific as possible.

Notes: This page will automatically progress after a set time of two minutes has passed.

Appendix D – Supplementary Tables

Supplementary Table S1

Factor Loadings and Parcel Description for Model 1, Chapter Two

Construct	Parcel	Items	*β* (*p*)
Trait Self-control	1	-I am good at resisting temptation -I do certain things that are bad for me if they are fun R[a] -Sometimes I can't stop myself from doing something, even if I know it is wrong R	.85 (< .001)
	2	-I wish I had more self-discipline R -People would say I have iron self-discipline -I often act without thinking through all the alternatives R	.76 (<.001)
	3	-I have a hard time breaking bad habits R -Pleasures and fun sometimes keep me from getting work done R	.75 (<.001)
Deliberative Decision-making	1	-I prefer to gather all the necessary information before committing to a decision -I weigh a number of different factors when making decisions	.89 (<.001)
	2	-In decision making, I take time to contemplate the pros/cons or risks/benefits of a situation	.81 (<.001)
	3	-I thoroughly evaluate decision alternatives before making a final choice -Investigating the facts is an important part of my decision-making process	.89 (<.001)
Intuitive Decision-making	1	-When making decisions, I rely mainly on my gut feelings -I weight feelings more than analysis in making decisions	.85 (<.001)
	2	-My initial hunch about decisions is generally what I follow -I make decisions based on intuition	.88 (<.001)
	3	-I rely on my first impressions when making decisions	.79 (<.001)
Self-reported Criminal Behavior	1	-Purposely damaged or destroyed property that did not belong to you -Been involved in a physical fight or shoving match, with another individual or group -Sold an illegal substance such as, but not limited to, marijuana, heroin, cocaine, or LSD	.86 (<.001)
	2	-Have broken into, or tried to break into, a building or vehicle -Use an illegal substance such as, but not limited to, marijuana, heroin, heroin, cocaine, or LSD	.49 (<.001)
	3	-Stolen, or tried to steal, a car, motorcycle, bicycle, or other form of -transportation (including "free-riding" on public transportation) -Knowingly bought, sold, or tried to buy/sell stolen goods Stolen something (including money)	.75 (<.001)
SDB	1	-I sometimes feel resentful when I don't get my way R -I'm always willing to admit when I make a mistake -I am sometimes irritated by people who ask favors of me -I have never deliberately said something to hurt someone's feelings	.61 (<.001)
	2	-It is sometimes hard for me go on with my work if I am not encouraged R -No matter who I am talking to, I'm always a good listener -There have been occasions when I took advantage of someone R -There have been times when I was quite jealous of the good fortunes of others R	.72 (<.001)
	3	-On a few occasions, I have given up doing something because I thought too little of my ability R -There have been times when I felt like rebelling against authority even though I knew they were right R -I sometimes try to get even, rather than forgive and forget -I am always courteous, even to people who are disagreeable -I have never been frustrated when people expressed ideas very different from my own	.69 (<.001)

Notes: [a] R – indicates reverse coding

Supplementary Table S2

Distribution and Multivariate Normality Statistics of Variables

Condition	Variable	Skewness	Kurtosis	Joint adj. χ^2 sig. test	Multivariate Normality
Depletion	Self-control	0.06	2.42***	(2) = 11.51**	χ^2 (10) = 1885.574 $p < 0.001$
	Deliberative Decision-making	-0.93***	4.20***	(2) = 52.26***	
	Intuitive Decision-making	0.06	2.64	(2) = 3.70	
	Self-reported Criminal Behavior	4.07***	26.24***	Not reported***	
	Social Desirability Bias	-0.16	2.52**	(2) = 8.77**	

Notes: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S3

Vignettes and Average Criminal Choice Measured in Percentage Likelihood

Vignette	Average Criminal Choice (SD)[a]
Illegal Downloading: You need a particular computer program for a personal project. The official version of the program costs about $160. You consider buying the program, but you think you won't be using it anymore after finishing the project. Therefore, you hesitate about buying it. A colleague has explained to you where and how you can easily, though illegally, download the program.	62.87 (31.46)
Illegal Streaming: You are with your friends and you're about to finish a season of your favorite television show. You use a legal website to stream the show, but that site stops working halfway through the episode. Your friend tells you about a different website that streams the show for free, though it is definitely not legal.	73.69 (29.21)
Petty Theft: You are at a convenience store after a long day of work. You haven't eaten since the morning because your manager kept you working through lunch. This is your one chance to buy food before you start the night shift at your second job. You are about to purchase a snack when you realize you don't have enough money to buy anything. However, you could slip the snack into your pocket and walk out the door.	12.46 (23.30)
Buying stolen goods: You need a new tablet, like an iPad. In the store, the tablet you want costs $400. One of your friends mentioned that he bought his tablet, which came in the original packaging, through one of his friends for about half price. Your friend told you that his friend has more new tablets for sale. Your friend also mentioned that the tablets probably "fell off a truck" somewhere, so there is no receipt. The tablets come in their original packaging. However, your friend does tell you that if you have any problems with the tablet within two years after the purchase, it will be replaced with a new one for free.	38.21 (32.55)

Notes: All vignettes were presented with the phrase, "Imagine…"

[a] Average criminal choice displayed is derived from the percentage estimate variable of each vignette.

Supplementary Table S4

Normality and Homogeneity Test of Variance for Control Variables in Chapter Three

Condition	Variable	Skewness	Kurtosis	Joint adj. χ^2 sig. test	Variance Ratio test
Depletion	Trait self-control	-0.08	2.58	(2) = 1.96	$F(196, 192) = 0.93$
	Intuitive decision-making	0.12	2.25**	(2) = 9.86**	$F(196, 192) = 1.01$
	Deliberative decision-making	-0.61***	3.29	(2) = 10.89**	$F(196, 192) = 0.78$
	Manipulation check index	-1.57***	5.34***	(2) = 47.23***	$F(196, 192) = 0.62$***
	Criminal Choice	-0.42*	2.80	(2) = 5.84*	$F(196, 192) = 0.94$
Control	Trait self-control	-0.05	2.79	(2) = 0.28	-
	Intuitive decision-making	0.07	2.32*	(2) = 6.95*	-
	Deliberative decision-making	-0.75***	3.62	(2) = 15.46***	-
	Manipulation check index	-0.12	2.17***	(2) = 13.18**	-
	Criminal Choice	-0.53**	3.03	(2) = 8.15*	-

Notes: The joint $_{adj}\chi^2$ column reports the adjusted chi-squared statistic for a skewness/kurtosis test of normality, where the null hypothesis is the data is normally distributed. The variance ratio test column compares the variable of interest between the two conditions with the null hypothesis being that the ratio between groups does not equal 1. While the intuitive decision-making index returned a significant chi-squared statistic in both groups, the histogram returns a reasonably normal distribution (Appendix E, Supplementary Figure S9A). Conversely, deliberative decision-making did not return a reasonably normal distribution (Appendix E, Supplementary Figure S9B) and as such a Mann-Whitney test was conducted. The manipulation check index was non-normally distributed and violated the assumption of homogeneity of variance, as such we report both a Mann-Whitney test as well as a Welch's *t*-test of unequal variance.

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S5

Comparison Structural Models with and without Latent Error Terms Constrained

Model	χ^2 (*df*)	χ^2 diff.		RMSEA (90%CI)	CFI	SRMR
1	(108) = 235.355 $p < .001$	-	-	.08 (0.06 , 0.09)	0.96	0.04
2	(119) = 263.097 <0.001	2 vs 1	(11) 27.74 $p = 0.0035$	.08 (0.07 , 0.09)	0.95	0.07

Notes: Model 1 is the model presented in text while model 2 is the model with the additional constraint requiring latent error terms to be equal across groups. Model fit was worse in model 2, particularly in regard to the χ^2 statistic and SRMR, and the variance explained was reduce by approximately 2.00% in the control group.

Supplementary Table S6

Indirect Effects Between Trait Self-control and Criminal Choice in the Control Group by Mediator

Mediator	Direct effect of trait self-control	Direct effect on criminal choice	Indirect effect (% of total)
Perceived Risk	0.12	-0.28*	-0.03 (18%)
Negative Affect	0.22*	-0.28*	-0.06 (27%)
Positive Affect	-0.17	0.49*	-0.08 (36%)
Social Consensus	-0.12	0.32*	-0.04 (18%)
Self-control	-	-0.15*	-0.22*

Notes: Only the control group's mediation analysis is presented as self-control did not have a significant indirect effect in the depletion group. All coefficients are standardized.

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S7

Magnitude Difference of Affective and Perceived Risk Predictors, Control Group

Predictor	Formula	Z – score (*p*)
Risk vs Positive Affect	$\frac{(-.0031806) - (.0515268)}{\sqrt{(.0013977)^2 + (.0057754)^2}}$	-9.21 (< 0.001)
Risk vs Negative Affect	$\frac{(-.0031806) - (-.0258564)}{\sqrt{(.0013977)^2 + (.006665)^2}}$	3.33 (< 0.001)
Negative vs Positive Affect	$\frac{(-.0258564) - (.0515268)}{\sqrt{(.006665)^2 + (.0057754)^2}}$	2.91 (0.003)

Notes: All z-scores were determined using: $Z = \frac{b_1 - b_2}{\sqrt{SEb_1^2 + SEb_2^2}}$

Supplementary Table S8

Distribution and Multivariate Normality Statistics of Variables by Condition

Condition	Variable	Skewness	Kurtosis	Joint adj. χ^2 sig. test	Multivariate Normality
Depletion	Self-control	-0.08	2.58	(2) = 1.96	χ^2 (12) = 44.736 p < .001
	Perceived Risk	0.99***	4.80*	(2) = 28.54*	
	Negative Affect	0.21	2.80	(2) = 1.74	
	Positive Affect	-0.15	2.51	(2) = 3.61	
	Social Consensus	-0.20	3.21	(2) = 2.10	
	Criminal Choice	-0.42*	2.80	(2) = 5.84	
Control	Self-control	-0.05	2.80	(2) = 0.28	χ^2 (12) = 48.415 p < .001
	Perceived Risk	1.18***	5.38***	(2) = 35.85*	
	Negative Affect	0.15	2.89	(2) = 0.81	
	Positive Affect	-0.30	2.60	(2) = 4.56	
	Social Consensus	-0.46*	3.21	(2) = 6.98*	
	Criminal Choice	-0.53*	3.03	(2) = 8.15*	

Notes: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S9

Comparison of Linear Regressions of Criminal Choice by Condition (Depletion vs Control)

Predictor	Depletion β (95%CI)	Control β (95%CI)
Perceived Risk	0.01 (-0.09, 0.12)	-0.16 (-0.27, -0.06)**
Positive Affect	0.52 (0.42, 0.62)***	0.45 (0.36, 0.55)***
Negative Affect	-0.33 (-0.44, -0.22)***	-0.32 (-0.43, -0.21)***
Perceived Social Consensus	0.19 (0.10, 0.28)***	0.16 (0.07, 0.25)***
Trait Self-control	-0.16 (-0.25, -0.07)***	-0.10 (-0.19, -0.02)*
N	197	193
F (df)	(5, 191) = 66.0***	(5, 187) = 75.3***
Adj. R^2	0.624	0.659
VIF (Range)	(1.05, 1.67)	(1.04, 1.52)
Durbin–Watson Statistic	2.05	2.31*
Cook's Distance (Max)	0.08	0.10
Shapiro-Wilk Statistic	1.0	1.0

Notes. The above models compare the linear regressions of Criminal Choice between the Depletion and Control Groups. Notably, and in line with the results presented in text, perceived risk is a significant predictor in the Control Group but not the Depletion Group. Q-Q and Residual Plots for each model may be found in Appendix E, Supplementary Figures S15 – S18.

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S10

Correlation of Outcome Variables, Pilot-test Chapter Four

	Walk away	Shove the guy	Hit the guy with a bottle
Walk away	-		
Shove the guy	-0.41***	-	
Hit the guy with a bottle	-0.32***	0.33***	-

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Table S11

Distribution and Multivariate Normality Statistics of Variables by Condition, Pilot-test Chapter Four

Condition	Variable	Skewness	Kurtosis	Joint adj. χ^2 sig. test	Multivariate Normality
Control	Walk away	-1.01**	2.51	(2) = 7.01**	χ^2 (6) = 95.902 $p < .001$
	Shove the guy	0.30	1.77***	(2) = 10.07**	
	Hit the guy with a bottle	1.81***	4.96*	(2) = 17.38***	
Essay Depletion	Walk away	-1.02**	3.00	(2) = 6.31*	χ^2 (6) = 117.591 $p < .001$
	Shove the guy	0.01	1.80**	(2) = 6.87*	
	Hit the guy with a bottle	3.69***	18.53***	(2) = 40.25***	
Stroop Depletion	Walk away	-0.76*	2.37	(2) = 4.67	χ^2 (6) = 28.657 $p < .001$
	Shove the guy	-0.34	1.89*	(2) = 5.96	
	Hit the guy with a bottle	1.76***	4.88*	(2) = 15.35***	

Notes: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S12

MANOVA of State Variables by Condition, Pilot-test Chapter Four

Statistic	Value	F ($df_{hypothesis}$, df_{error})	p
Wilks Lambda	.89	2.30 (6, 230)	.04
Pillai's Trace	.11	2.28 (6, 232)	.04
Lawley-Hotelling Trace	.12	2.33 (6, 228)	.03
Roy's Largest Root	.11	4.34 (3, 116)	.01

Supplementary Table S13

Test of Normality of Homogeneity of Variance of Control variables by VR/Written Condition

Condition	Variable	Skewness	Kurtosis	Joint adj. χ^2 sig. test	Variance Ratio test
VR	Trait self-control	0.59	2.59	(2) = 3.41	F (45, 197) = 0.65, p = 0.09
	Trait aggressiveness	0.23	2.73	(2) = 0.50	F (45, 197) = 0.59, p = 0.04*
	Intuitive decision-making	0.60	2.86	(2) = 3.40	F (45, 197) = 0.53, p = 0.01**
	Deliberative decision-making	-0.43	2.72	(2) = 1.82	F (45, 197) = 0.68, p = 0.13
Written	Trait self-control	-0.07	2.78	(2) = 0.45	-
	Trait aggressiveness	0.27	2.54	(2) = 4.74	-
	Intuitive decision-making	0.16	2.80	(2) = 1.08	-
	Deliberative decision-making	-0.87***	3.62	(2) = 19.10***	-

Notes: The $_{adj}\chi^2$ column reports the adjusted chi-squared statistic for a skewness/kurtosis test of normality, where the null hypothesis is the data is normally distributed. The variance ratio test column compares the variable of interest between the two conditions the null hypothesis being that the ratio between groups does not equal 1. As can be observed, as both trait aggressiveness and intuitive decision-making violate the homogeneity of variance assumption, a Welch's t-test was used. Additionally, deliberative decision-making in the written condition was not reasonably normally distributed, and as such and Mann-Whitney test was used.

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S14

Test of Normality of Homogeneity of Variance of Control Variables, by Control/Depletion Condition

Condition	Variable	Skewness	Kurtosis	Joint adj. χ^2 sig. test	Variance Ratio test
Control N = 122	State self-control	-0.71*	3.17	(2) = 8.86*	$F(121, 121) = 0.90$, $p = 0.55$
	Manipulation Check Index	0.29	1.95***	(2) = 19.12***	$F(121, 121) = 1.15$, $p = 0.45$
	PANAS – Positive	-0.09	2.62	(2) = 0.82	$F(121, 121) = 1.30$, $p = 0.15$
	PANAS – Negative	1.39***	4.90**	(2) = 27.18***	$F(121, 121) = 1.08$, $p = 0.66$
Depletion N = 122	State self-control	-0.34	2.51	(2) = 5.05	-
	Manipulation Check Index	-0.53*	2.86	(2) = 5.55	-
	PANAS – Positive	-0.33	2.56	(2) = 3.43	-
	PANAS – Negative	0.84***	2.93	(2) = 10.81**	-

Notes: The $_{adj}\chi^2$ column reports the adjusted chi-squared statistic for a skewness/kurtosis test of normality, where the null hypothesis is the data is normally distributed. The variance ratio test column compares the variable of interest between the two conditions the null hypothesis being that the ratio between groups does not equal 1. As can be seen, the negative PANAS subscale was non-normally distributed in both conditions. Furthermore, state self-control and the manipulation check index was non-normally distributed in the control condition. As such, a Mann-Whitney test was used for their relative comparisons.

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S15

Test of Normality of Homogeneity of Variance of Control Variables, by VR/Witten Condition

Condition	Variable	Skewness	Kurtosis	Joint adj. χ^2 sig. test	Variance Ratio test
VR	Presence	-0.51	2.77	(2) = 2.44	F (45, 197) = 0.54, p = 0.02*
	Realism	-0.88*	3.66	(2) = 7.01*	F (45, 197) = 1.02, p = 0.89
Written	Presence	-0.02	2.78	(2) = 0.25	-
	Realism	-0.09	2.32**	(2) = 7.31	-

Notes: The $_{adj}\chi^2$ column reports the adjusted chi-squared statistic for a skewness/kurtosis test of normality, where the null hypothesis is the data is normally distributed. The variance ratio test column compares the variable of interest between the two conditions the null hypothesis being that the ratio between groups does not equal 1. As can be observed, presence violates the assumption of homogeneity of variance, as such as Welch's t-test was used. Additionally, realism was non-normally distributed in both conditions, as such a Mann-Whitney test was used.

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S16

Comparison of Condition (VR vs. Written) on Subjective Presence and Realism with and Without Trait Aggressiveness as a Covariate

Predictors	Presence (*F*, *d*)	Presence (F, *d*)	Realism (*F*, *d*)	Realism (*F*, *d*)
Condition	(1,242) = 56.8 *** *d* = 0.81	(1, 241) = 44.56 *** *d* = 0.84	(1, 242) = 2.95 *d* = 0.20	(1, 241) = 2.99 *d* = 0.22
Trait Aggressiveness	-	(1, 241) = 8.68 ** *d* = 0.35	-	(1, 241) = 0.05 *d* = 0.00
N	244	244	244	244
Shapiro Wilk	*W* = 0.99	*W* = 1.00	*W* = 0.99 *	*W*= 0.99 *
Levene's Test of Homogeneity of Variance	(1, 242) = 5.01 *	(1, 242) = 2.96	(1, 242) = 0.05	(1, 242) = 0.04

Notes: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S17

χ^2 Distribution of Discrete Criminal Choice by Conditions

Discrete Criminal Choice	**VR – Control** ***N*** (%)	**Written – Control** ***N*** (%)	**VR - Depletion** ***N*** (%)	**Written - Depletion** ***N*** (%)	**Total**
Walk away	15 (65%)	61 (62%)	17 (74%)	61 (61%)	154 (63%)
Shove the guy	7 (30%)	38 (38%)	6 (26%)	35 (35%)	86 (35%)
Hit the guy with a bottle	1 (4%)	0 (0%)	0 (0%)	3 (3%)	4 (2%)
Total	23 (100%)	99 (100%)	23 (100%)	99 (100%)	244 (100%)

Notes: χ^2 (6) = 5.68, p = 0.459

Supplementary Table S18

*2 (VR vs. Written) x 2(Depletion vs. Control) MANOVA of Criminal Choice with and Without Controlling for Trait Aggression and the PANAS (*N = 244)

		Full Model	VR vs. Written	Depletion vs. Control	Interaction	Trait Aggressiveness	PANAS-Negative	PANAS-Positive
MANOVA	Wilk's Lambda	$F(9, 579.4) = 1.68$	$F(3, 238) = 1.96$	$F(3, 238) = 0.19$	$F(3, 236) = 0.10$	-	-	-
	Phillai's Trace	$F(9, 720) = 1.68$	$F(3, 238) = 1.96$	$F(3, 238) = 0.19$	$F(3, 236) = 0.10$	-	-	-
	Lawley-Hotelling	$F(9, 710) = 1.60$	$F(3, 238) = 1.96$	$F(3, 238) = 0.19$	$F(3, 236) = 0.10$	-	-	-
	Race Roy's Largest Root	$F(3, 240) = 3.40$ *	$F(3, 238) = 1.96$	$F(3, 238) = 0.19$	$F(3, 236) = 0.10$	-	-	-
		Full Model	**VR vs. Written**	**Depletion vs. Control**	**Interaction**	**Trait Aggressiveness**	**PANAS-Negative**	**PANAS-Positive**
MANCOVA	Wilk's Lambda	$F(18, 665.20) = 4.38$***	$F(3, 235) = 1.74$	$F(3, 235) = 0.81$	$F(3, 235) = 0.25$	$F(3, 235) = 14.83$***	$F(3, 235) = 0.40$	$F(3, 235) = 1.46$
	Phillai's Trace	$F(18, 711.0) = 4.15$***	$F(3, 235) = 1.74$	$F(3, 235) = 0.81$	$F(3, 235) = 0.25$	$F(3, 235) = 14.83$***	$F(3, 235) = 0.40$	$F(3, 235) = 1.46$
	Lawley-Hotelling	$F(18, 701) = 4.59$***	$F(3, 235) = 1.74$	$F(3, 235) = 0.81$	$F(3, 235) = 0.25$	$F(3, 235) = 14.83$***	$F(3, 235) = 0.40$	$F(3, 235) = 1.46$
	Race Roy's Largest Root	$F(6, 237) = 11.58$***	$F(3, 235) = 1.74$	$F(3, 235) = 0.81$	$F(3, 235) = 0.25$	$F(3, 235) = 14.83$***	$F(3, 235) = 0.40$	$F(3, 235) = 1.46$

Notes: * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Supplementary Table S19

*2 (VR vs. Written) x 2(Depletion vs. Control) ANOVA of Criminal Choice Controlling for Trait Aggression and the PANAS (*N = 244)

Just Walk Away						
Predictor	**Sum of Squares**	***Df***	**Mean Square**	***F***	***p***	***η²***
Overall Model	70.98	6	11.83	5.15	< 0.001	-
VR vs. Depletion	4.21	1	4.21	1.34	0.24	0.01
Depletion vs. Control	2.57	1	2.57	0.82	0.37	0.00
Interaction	0.33	1	0.33	0.11	0.75	0.00
Trait Aggressiveness	63.43	1	63.43	20.27	< 0.001	0.08
PANAS-Negative	0.44	1	0.44	0.14	0.71	0.01
PANAS-Positive	0.00	1	0.00	0.00	0.99	0.00
Residuals	741.37	237	3.13	-	-	-
Adj. R^2	0.09					
Shove the guy						
Predictor	**Sum of Squares**	***Df***	**Mean Square**	***F***	***p***	***η²***
Overall Model	113.98	6	19.00	8.60	< 0.001	-
VR vs. Depletion	0.07	1	0.07	0.03	0.87	0.00
Depletion vs. Control	0.03	1	0.03	0.01	0.92	0.00
Interaction	0.76	1	0.76	0.25	0.62	0.00
Trait Aggressiveness	101.97	1	101.97	33.17	< 0.001	0.12
PANAS-Negative	2.29	1	2.29	0.75	0.39	0.00
PANAS-Positive	8.86	1	8.86	2.88	0.09	0.01
Residuals	728.58	237	3.07	-	-	-
Adj. R^2	0.16					
Hit the guy with a bottle						
Predictor	**Sum of Squares**	***Df***	**Mean Square**	***F***	***p***	***η²***
Overall Model	35.74	6	5.96	7.47	< 0.001	-
VR vs. Depletion	4.73	1	4.73	4.03	0.04	0.02
Depletion vs. Control	0.59	1	0.59	0.503	0.48	0.00
Interaction	0.79	1	0.79	0.67	0.41	0.00
Trait Aggressiveness	28.45	1	28.45	24.19	< 0.001	0.09
PANAS-Negative	0.90	1	0.90	0.77	0.38	0.00
PANAS-Positive	2.70	1	2.70	0.23	0.63	0.00
Residuals	278.67	237	1.18			
Adj. R^2	0.14					

Supplementary Table S20

Comparison of Logistic Regression of Non-criminal (0) and Criminal (1) Behavior with Dummy Coded Condition (1 = VR-Depletion; 0 = All Other Conditions)

Predictor	Model 1 OR (95%CI)	Model 2 OR (95%CI)
Condition (Written-Control)	Reference	All Other Conditions
VR-control	0.86 (0.33, 2.21)	-
VR-depletion	0.57 (0.21, 1.56)	0.58 (0.22, 1.52)
Written-depletion	1.00 (0.56, 1.77)	-
Constant	0.62* (0.45, 0.93)	0.61*** (0.47, 0.80)
N	244	244
Likelihood Ratio χ^2 (df)	(3) = 1.45	(1) = 1.33
McFadden's R^2	0.00	0.00
Deviance	320	320
AIC	328	324
Sensitivity	0.00%	00%
Specificity	100%	100%
AUC	0.53	0.522
VIF (Range)	1.00	1.00

Supplementary Table S21

Linear Regression of 'Just Walk Away', Full Sample

Predictor	Model 1 β (95%CI)	Model 2 β (95%CI)	Model 3 β (95%CI)	Model 4 β (95%CI)
Condition (Written-Control)		Reference		
VR-control	0.29 (-0.16, 0.75)	0.48* (0.02, 0.95)	0.30 (-0.16, 0.77)	0.18 (-0.28, 0.64)
VR-depletion	0.43 (-0.02, 0.89)	0.64** (0.17, 1.11)	0.47* (0.00, 0.94)	0.37 (-0.09, 0.83)
Written-depletion	0.13 (-0.15, 0.40)	0.13 (0.14, 0.41)	0.14 (-0.13, 0.41)	0.10 (-0.16, 0.37)
Presence	-	-0.21** (-0.37, -0.05)	-0.09 (-0.26, 0.08)	-0.08 (-0.25, 0.09)
Realism	-	0.00 (-0.15, 0.16)	0.00 (-0.15, 0.15)	-0.03 (-0.18, 0.12)
Perceived Risk	-	-	0.17** (0.04, 0.30)	0.12 (-0.01, 0.25)
Positive Affect	-	-	-0.01 (-0.14, 0.12)	0.03 (-0.11, 0.16)
Negative Affect	-	-	0.06 (-0.11, 0.22)	0.09 (-0.08, 0.27)
State Anger	-	-	-0.25** (-0.43, -0.08)	-0.20* (-0.38, -0.03)
Trait Aggressiveness	-	-	-	-0.24*** (-0.38, -0.10)
PANAS – Negative	-	-	-	-0.03 (-0.17, -.012)
PANAS – Positive	-	-	-	0.04 (-0.09, 0.17)
N	244	244	244	244
F(df)	(3, 240) = 1.47	(5, 238) = 2.75*	(9, 234) = 3.41***	(12, 231) = 3.89***
Adj. R^2	0.02	0.05	0.12	0.17
Durbin-Watson Statistic	1.94	1.98	1.93	1.97
Cook's Distance (Maximum)	0.08	0.05	0.04	0.04
Shapiro-Wilk	0.89***	0.93***	0.95***	0.95***
VIF (Range)	1.00	1.02 - 1.30	1.04 – 1.45	
ΔR^2	-	0.04	0.06	0.05
ΔF(df)	-	(2, 238) = 4.59 **	(4, 234) = 4.07***	(3, 231) = 4.81***

Notes: When comparing this with the logistic regression model presented in text, the results returned are very similar regarding the direction of relationship and significance.

* $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Table S22

Linear Regression of 'Shove the Guy", Full Sample

Predictor	Model 1 β (95%CI)	Model 2 β (95%CI)	Model 3 β (95%CI)	Model 4 β (95%CI)
Condition (Written-Control)			Reference	
VR-control	-0.10 (-0.56, 0.36)	-0.42 (-0.88, 0.03)	-0.22 (-0.67, 0.23)	-0.06 (-0.49, 0.37)
VR-depletion	-0.05 (-0.51, 0.41)	-0.41 (-0.86, 0.05)	-0.22 (-0.66, 0.23)	-0.12 (-0.55, 0.32)
Written-depletion	0.07 (-0.21, 0.36)	0.06 (-0.20, 0.33)	0.05 (-0.21, 0.31)	0.08 (-0.17, 0.33)
Presence	-	0.34*** (0.19, 0.50)	0.20* (0.03, 0.36)	0.18* (0.02, 0.33)
Realism	-	0.03 (-0.12, 0.18)	0.04 (-0.10, 0.19)	0.07 (-0.07, 0.21)
Perceived Risk	-	-	-0.16* (-0.28, -0.03)	-0.11 (-0.23, 0.02)
Positive Affect	-	-	0.06 (-0.07, 0.18)	-0.01 (-0.13, 0.12)
Negative Affect	-	-	0.01 (-0.15, 0.17)	-0.04 (-0.20, 0.13)
State Anger	-	-	0.24** (0.07, 0.41)	0.17* (0.01, 0.34)
Trait Aggressiveness	-	-	-	0.30*** (0.17, 0.43)
PANAS – Negative	-	-	-	0.04 (-0.09, 0.18)
PANAS – Positive	-	-	-	0.03 (-0.09, 0.15)
N	244	244	244	244
F(df)	(3, 240) = 0.25	(5, 238) = 6.23***	(9, 234) = 6.03***	(12, 231) = 7.07***
Adj. R^2	-0.01	0.10	0.16	0.23
Durbin-Watson Statistic	1.88	1.94	1.94	1.96
Cook's Distance (Maximum)	0.04	0.02	0.03	0.04
Shapiro-Wilk	0.93***	0.97***	0.97***	0.98***
VIF (Range)	1.00	1.03 – 1.30	1.04 – 1.45	1.05 – 1.49
ΔR^2	-	0.11	0.07	0.08
ΔF(df)	-	(2, 238) = 15.15***	(4, 234) = 5.23 ***	(3, 231) = 8.46***

Notes: When comparing this with the logistic regression model presented in text, the results returned are very similar regarding the direction of relationship and significance.

* $p < .05$; **$p < .01$; *** $p < .001$

Supplementary Table S23

Linear Regression of 'Hit the Guy with a Bottle", Full Sample

Predictor	Model 1 β (95%CI)	Model 2 β (95%CI)	Model 3 β (95%CI)	Model 4 β (95%CI)
Condition (Written-Control)		Reference		
VR-control	-0.38 (-0.82, 0.08)	-0.48* (-0.95, -0.02)	-0.32 (-0.78, 0.14)	-0.19 (-0.64, 0.27)
VR-depletion	-0.34 (-0.79, 0.11)	-0.45 (-0.92, 0.02)	-0.29 (-0.75, 0.18)	-0.17 (-0.63, 0.28)
Written-depletion	0.20 (-0.08, 0.48)	0.20 (-0.08, 0.47)	0.17 (-0.09, 0.45)	0.23 (-0.03, 0.50)
Presence	-	0.14 (-0.03, 0.30)	-0.01 (0.18, 0.16)	-0.03 (-0.20, 0.14)
Realism	-	-0.05 (-0.20, 0.10)	-0.02 (-0.17, 0.13)	0.02 (-0.13, 0.16)
Perceived Risk	-	-	-0.19** (-0.32, -0.06)	-0.15* (-0.27, -0.02)
Positive Affect	-	-	0.08 (-0.05, 0.21)	0.05 (-0.08, 0.18)
Negative Affect	-	-	0.14 (-0.03, 0.31)	0.12 (-0.05, 0.30)
State Anger	-	-	0.10 (-0.07, 0.28)	0.04 (-0.13, 0.22)
Trait Aggressiveness	-	-	-	0.28*** (0.15, 0.42)
PANAS – Negative	-	-	-	-0.02 (-0.16, 0.13)
PANAS – Positive	-	-	-	-0.06 (-0.18, 0.07)
N	244	244	244	244
F(df)	(3, 240) = 3.31*	(5, 238) = 2.55*	(9, 234) = 3.77***	(12, 231) = 4.55***
Adj. R^2	0.03	0.03	0.09	0.15
Durbin-Watson Statistic	2.00	2.00	1.95	2.01
Cook's Distance (Maximum)	0.05	0.08	0.08	0.08
Shapiro-Wilk	0.69***	0.72***	0.79***	0.84***
VIF (Range)	1.00	1.0 – 1.30	1.04 – 1.45	1.05 – 1.49
ΔR^2	-	0.01	0.08	0.06
ΔF(df)	-	(2, 238) = 1.39	(4, 234) = 5.09 ***	(2, 231) = 6.13***

Notes: When comparing this with the logistic regression model presented in text, the results returned are very similar in regard to direction of relationship and significance.

* $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Table S24

*Sample Characteristics by Condition Matched by Average Age and Modal Responses (*N = *218)*

Characteristic	VR Participants	Written Participants	Matched - Written Participants
N	46	198	172
Sex	100% Male	100% Male	100% Male
Age	***M* = 26** (*SD* = 8)	*M* = 29 (*SD* = 10)	***M* = 26** (*SD* = 5)
Ethnicity	Modal Response (65%) – White	Modal Response (84%) - White	Modal Response (85%) – White
Employment Status	**Modal Response (67%) – Full-time student**	Modal Response (37%) – Employed full-time	**Modal Response (40%) – Full-time student**
Education	Modal Response (58%) – Undergraduate or Higher	Modal Response (69%) – Undergraduate or Higher	Modal Response (69%) – Undergraduate or Higher
Marriage Status	Modal Response (72%) - Single	Modal Response (56%) - Single	Modal Response (57%) - Single

Notes: Originally, participants in the written condition were on average older and the modal response for employment status was being employed full-time. A rudimentary matched sample was created to ensure participants in the written condition were not significantly different in regard to age and the modal responses for all other demographics were the same.

Supplementary Table S25

χ^2 Distribution of Discrete Criminal Choice by Conditions with Samples Matched on Demographics

Discrete Criminal Choice	VR – Control *N* (%)	Written – Control *N* (%)	VR - Depletion *N* (%)	Written - Depletion *N* (%)	Total
Walk away	15 (65%)	52 (59%)	17 (74%)	49 (58%)	133 (61%)
Shove the guy	7 (30%)	36 (41%)	6 (26%)	33 (39%)	82 (38%)
Hit the guy with a bottle	1 (4%)	0 (0%)	0 (0%)	2 (2%)	3 (1%)
Total	23 (100%)	88 (100%)	23 (100%)	84 (100%)	218 (100%)

Notes: χ^2 (6) = 5.91, p = 0.433

Supplementary Table S26

*MANOVA of Criminal Choice Variables by Condition with Sample Matched on Demographics (*N = 218)

Source	Statistic	Value	*F* ($df_{hypothesis}$, df_{error})	*p*
Full Model	Wilks Lambda	.75	4.30 (15, 580.1)	< .001
	Pillai's Trace	.26	4.06 (15, 636)	< .001
	Lawley-Hotelling Trace	.32	4.51 (15, 626)	< .001
	Roy's Largest Root	.28	11.84 (5, 212)	< .001
Condition	Wilks Lambda	.95	1.33 (9, 511.2)	0.22
	Pillai's Trace	.06	1.33 (9, 636)	0.22
	Lawley-Hotelling Trace	.06	1.32 (9, 626)	0.22
	Roy's Largest Root	.04	2.55 (3, 212)	0.06
Trait Aggression	Wilks Lambda	.85	12.29 (3, 210)	< .001
	Pillai's Trace	.15	12.29 (3, 210)	< .001
	Lawley-Hotelling Trace	.18	12.29 (3, 210)	< .001
	Roy's Largest Root	.18	12.29 (3, 210)	< .001
PANAS-Negative	Wilks Lambda	.99	0.39 (3, 210)	0.76
	Pillai's Trace	.01	0.39 (3, 210)	0.76
	Lawley-Hotelling Trace	.01	0.39 (3, 210)	0.76
	Roy's Largest Root	.01	0.39 (3, 210)	0.76

Supplementary Table S27

Logistic Regression of Non-criminal (0) and Criminal (1) Behavior with a Matched Sample

Predictor	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 3 OR (95%CI)	Model 4 OR (95%CI)
Condition (Written-Control)		Reference		
VR-control	0.77 (0.30, 2.01)	0.44 (0.16, 1.22)	0.69 (0.22, 2.11)	0.94 (0.30, 2.97)
VR-depletion	0.51 (0.18, 1.42)	0.27* (0.09, 0.80)	0.36 (0.11, 1.18)	0.42 (0.12, 1.45)
Written-depletion	1.03 (0.56, 1.89)	1.07 (0.57, 2.01)	1.01 (0.51, 2.00)	1.13 (0.54, 2.33)
Presence	-	1.90*** (1.28, 2.82)	1.44 (0.92, 2.26)	1.42 (0.89, 2.27)
Realism	-	1.02 (0.72, 1.44)	1.04 (0.70, 1.53)	1.10 (0.72, 1.66)
Perceived Risk	-	-	0.47*** (0.33, 0.68)	0.48*** (0.33, 0.71)
Positive Affect	-	-	1.02 (0.74, 1.42)	0.94 (0.66, 1.34)
Negative Affect	-	-	0.96 (0.63, 1.47)	0.90 (0.56, 1.45)
State Anger	-	-	2.00 (1.27, 3.18)	1.81* (1.13, 2.90)
Trait Aggressiveness	-	-	-	1.96*** (1.33, 2.90)
PANAS – Negative	-	-	-	0.91 (0.62, 1.33)
PANAS – Positive	-	-	-	1.04 (0.73, 1.49)
Constant	0.69 (9.45, 1.06)	0.74 (0.48, 1.16)	0.66 (0.41, 1.07)	0.58* (0.34, 0.96)
N	218	218	218	218
Likelihood Ratio χ^2 (df)	(3) = 2.26	(5) = 19.05**	(9) = 49.12***	(12) = 62.47***
McFadden's R^2	0.01	0.07	0.17	0.21
Deviance	289	273	242	229
AIC	297	285	262	225
Sensitivity	0.00%	36.50%	55.30%	61.20%
Specificity	100%	85.70%	84.20%	85.70%
AUC	0.54	0.68	0.76	0.80
VIF (Range)	1.00	1.03 – 1.31	1.04 – 1.36	1.06 – 1.39
Difference from previous model χ^2 (df)	-	(2) = 16.80***	(4) = 30.01***	(3) = 13.40**

Notes: When comparing this model with a matched sample on education and age to the model presented in text, the results returned are very similar in regard to direction of relationship and significance (Table 14; Chapter Four).

* $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Table S28

Linear Regression of 'Just Walk Away", Matched Sample

Predictor	Model 1 β (95%CI)	Model 2 β (95%CI)	Model 3 β (95%CI)	Model 4 β (95%CI)
Condition (Written-Control)		Reference		
VR-control	0.33 (-0.13, 0.79)	0.51* (0.04, 0.98)	0.34 (-0.12, 0.81)	0.20 (-0.27, 0.67)
VR-depletion	0.47* (0.01, 0.93)	0.67** (0.20, 1.15)	0.51* (0.04, 0.99)	0.40 (-0.07, 0.87)
Written-depletion	0.14 (-0.16, 0.44)	0.13 (-0.17, 0.42)	0.15 (-0.14, 0.44)	0.12 (-0.17, 0.40)
Presence	-	-0.19* (-0.36, -0.02)	-0.07 (-0.25, 0.12)	-0.05 (-0.24, 0.13)
Realism	-	-0.05 (-0.21, 0.11)	-0.05 (-0.21, 0.11)	-0.08 (-0.24, 0.08)
Perceived Risk	-	-	0.16* (0.03, 0.30)	0.13 (-0.01, 0.26)
Positive Affect	-	-	-0.02 (-0.16, 0.12)	0.02 (-0.12, 0.16)
Negative Affect	-	-	0.02 (-0.16, 0.20)	0.07 (-0.12, 0.26)
State Anger	-	-	-0.22* (-0.41, -0.03)	-0.18 (-0.36, 0.01)
Trait Aggressiveness	-	-	-	-0.24*** (-0.38, -0.09)
PANAS – Negative	-	-	-	-0.03 (-0.18, 0.13)
PANAS – Positive	-	-	-	0.02 (-0.12, 0.16)
N	218	218	218	218
F(df)	(2, 214) = 1.73	(5, 212) = 2.97**	(9, 208) = 3.20***	(12, 205) = 3.53***
Adj. R^2	0.02	0.07	0.12	0.17
Durbin-Watson Statistic	1.96	1.98	1.96	2.01
Cook's Distance (Maximum)	0.08	0.05	0.04	0.04
Shapiro-Wilk	0.91***	0.93***	0.95***	0.96***
VIF (Range)	1.00	1.03 – 1.32	1.04 – 1.46	1.06 – 1.49
ΔR^2	-	0.04	0.06	0.05
Δ*F*(df)	-	(2, 212) = 4.74**	(4, 208) = 3.32**	(3, 205) = 4.09**

Notes: When comparing this with the linear regression models with a full sample, the results returned are very similar in regard to direction of relationship and significance.

* $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Table S29

Linear Regression of 'Shove the Guy", Matched Sample

Predictor	Model 1 β (95%CI)	Model 2 β (95%CI)	Model 3 β (95%CI)	Model 4 β (95%CI)
Condition (Written-Control)		Reference		
VR-control	-0.18 (-0.64, 0.28)	-0.48* (-0.93, -0.03)	-0.27 (-0.71, 0.17)	-0.10 (-0.54, 0.33)
VR-depletion	-0.13 (-0.60, 0.33)	-0.47* (-0.93, -0.02)	-0.26 (-0.71, 0.18)	-0.16 (-0.59, 0.28)
Written-depletion	0.08 (-0.22, 0.38)	0.09 (-0.19, 0.38)	0.08 (-0.20, 0.34)	0.09 (-0.17, 0.36)
Presence	-	0.32*** (0.16, 0.49)	0.16 (-0.02, 0.33)	0.13 (-0.03, 0.30)
Realism	-	0.07 (-0.08, 0.23)	0.08 (-0.07, 0.23)	0.10 (-0.05, 0.25)
Perceived Risk	-	-	-0.19** (-0.32, -0.06)	-0.15* (-0.28, -0.03)
Positive Affect	-	-	0.05 (-0.08, 0.17)	-0.01 (-0.14, 0.12)
Negative Affect	-	-	0.05 (-0.12, 0.22)	-0.01 (-0.18, 0.17)
State Anger	-	-	0.24** (0.07, 0.42)	0.18* (0.01, 0.36)
Trait Aggressiveness	-	-	-	0.29*** (0.16, 0.42)
PANAS – Negative	-	-	-	0.03 (-0.11, 0.18)
PANAS – Positive	-	-	-	0.04 (-0.08, 0.17)
N	218	218	218	218
F(df)	(3, 214) = 0.55	(5, 212) = 6.16***	(9, 208) = 6.51***	(12, 205) = 7.22***
Adj. R^2	-0.01	0.11	0.19	0.26
Durbin-Watson Statistic	2.05	2.06	2.08	2.12
Cook's Distance (Maximum)	0.04	0.03	0.04	0.5
Shapiro-Wilk	0.94***	0.97***	0.98**	0.98*
VIF (Range)	1.00	1.03 – 1.32	1.04 – 1.46	1.06 – 1.51
ΔR^2	-	0.12	0.9	0.8
ΔF(df)	-	(2, 212) = 14.48***	(4, 208) = 6.19***	(3, 205) = 7.52***

Notes: When comparing this with the linear regression models with a full sample, the results returned are very similar in regard to direction of relationship and significance.

* $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Table S30

Linear Regression of 'Hit the Guy with a Bottle", Matched Sample

Predictor	Model 1 β (95%CI)	Model 2 β (95%CI)	Model 3 β (95%CI)	Model 4 β (95%CI)
Condition (Written-Control)		Reference		
VR-control	-0.43 (-0.88, 0.03)	-0.54* (-1.01, -0.06)	-0.37 (-0.84, 0.09)	-0.24 (-0.70, 0.22)
VR-depletion	-0.39 (-0.84, 0.07)	-0.51* (-0.98, -0.03)	-0.34 (-0.81, 0.13)	-0.22 (-0.69, 0.24)
Written-depletion	0.19 (-0.11, 0.49)	0.20 (-0.10, 0.49)	0.18 (-0.11, 0.46)	0.23 (-0.05, 0.51)
Presence	-	0.15 (-0.2, 0.32)	-0.01 (-0.20, 0.17)	-0.03 (-0.21, 0.14)
Realism	-	-0.08 (-0.24, 0.08)	-0.04 (-0.20, 0.12)	-0.01 (-0.17, 0.14)
Perceived Risk	-	-	-0.18** (-0.32, -0.05)	-0.16* (-0.29, -0.02)
Positive Affect	-	-	0.12 (-0.02, 0.25)	0.09 (-0.05, 0.23)
Negative Affect	-	-	-.17 (-0.00, 0.35)	0.16 (-0.2, 0.35)
State Anger	-	-	0.07 (-0.11, 0.26)	0.03 (-0.16, 0.21)
Trait Aggressiveness	-	-	-	0.26*** (0.11, 0.40)
PANAS – Negative	-	-	-	-0.04 (-0.20, 0.11)
PANAS – Positive	-	-	-	-0.04 (-0.17, 0.10)
N	218	218	218	218
F(df)	(3, 214) = 3.66*	(5, 212) = 2.77*	(9, 208) = 3.97***	(12, 205) = 4.20***
Adj. R^2	0.05	0.04	0.11	0.15
Durbin-Watson Statistic	2.00	2.01	2.01	2.08
Cook's Distance (Maximum)	0.06	0.08	0.09	0.09
Shapiro-Wilk	0.72***	0.76***	0.81***	0.85***
VIF (Range)	1.00	1.03 – 1.32	1.04 – 1.46	1.06 – 1.51
ΔR^2	-	-0.01	0.09	0.05
ΔF(df)	-	(2, 212) = 1.41	(4, 208) = 5.20***	(3, 205) = 4.32**

Notes: When comparing this with the linear regression models with a full sample, the results returned are very similar in regard to direction of relationship and significance.

* $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Table S31

χ^2 Distribution of Discrete Criminal Choice by Control Conditions (VR versus Written)

Discrete Criminal Choice	Written ***N*** (%)	VR ***N*** (%)	Total
Walk away	61 (62%)	15 (65%)	76 (62%)
Shove the guy	38 (38%)	7 (30%)	45 (37%)
Hit the guy with a bottle	0 (0%)	1 (4%)	1 (1%)
Total	99 (100%)	23 (100%)	122 (100%)

Notes: $\chi^2(2) = 4.66$, $p = 0.10$

Supplementary Table S32

Group Comparison of Likert Criminal Choice by Control Conditions (VR versus Written)

Construct	Written $N = 99$	VR $N = 23$	Significance
	M (*SD*)	*M* (*SD*)	
Walk away	4.89 (1.99)	5.43 (1.67)	$Z = -0.99$, $p = 0.3206$
Shove the guy	3.71 (2.08)	3.52 (1.88)	$Z = 0.27$, $p = 0.7855$
Hit the guy with a bottle	1.57 (1.06)	1.13 (0.34)	$Z = 1.90$, $p = 0.0585$

Notes: As all Likert outcome variables were non-normally distributed a Mann-Whitney test was conducted. There was a marginally significant difference between the two control conditions ($p = 0.0585$) for the Likert outcome variable "Hit the guy with the bottle" with people in the written condition indicating a greater likelihood ($M = 1.57$, $SD = 1.06$) compared to participants in the VR condition ($M = 1.13$, $SD = 0.34$; $M_{diff} = 0.44$, 95% CI [-0.01, 0.89], $d = 0.45$, 95% CI [-0.01, 0.91]). However, considering the χ^2 analysis, that the mean difference as well as Cohen's *d* confidence intervals both contain zero, and the *p*-value is only marginally significant – it was reasonable to conclude there was no significant difference.

Supplementary Table S33

MANOVA of Criminal Choice Variables by Condition (Video vs. Written), Chapter Five

Source	Statistic	Value	$F\ (df_{hypothesis}, df_{error})$	*p*
Full Model	Wilks Lambda	0.98	1.87 (3, 313)	0.135
	Pillai's Trace	0.02	1.87 (3, 313)	0.135
	Lawley-Hotelling Trace	0.02	1.87 (3, 313)	0.135
	Roy's Largest Root	0.02	1.87 (3, 313)	0.135

Supplementary Table S34

Binomial Logistic Regression of Criminal Behavior on Existing and New Deterrents and Drivers Interacted with Condition

Predictor	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Condition	0.86 (0.57, 1.30)	0.83 (0.45, 1.56)	1.07 (0.47, 2.46)
Existing Deterrents	-	0.48*** (0.32, 0.72)	0.45*** (0.30, 0.69)
Existing Drivers	-	3.58** (1.49, 8.62)	3.46** (1.45, 8.23)
New Deterrents	-	0.19*** (0.11, 0.34)	0.19*** (0.11, 0.33)
New Drivers	-	6.44*** (3.72, 11.14)	6.50*** (3.71, 11.41)
Condition* Existing Deterrents	-	-	0.74 (0.49, 1.12)
Condition* Existing Drivers	-	-	Removed Due to Collinearity
Condition* New Deterrents	-	-	0.81 (0.46, 1.42)
Condition* New Drivers	-	-	1.02 (0.58, 1.78)
Intercept	0.90 (0.67, 1.20)	0.92 (0.53, 1.59)	0.79 (0.41, 1.51)
Deviance	494	245	243
AIC	498	257	261
χ^2 (df), p	(1) = 0.51	(5) = 239.35***	(8) = 251.88***
VIF (Range)	1.00	1.01 – 1.09	1.04 – 1.73
McFadden's R^2	0.00	0.50	0.51
Specificity	100%	91.80%	90.80%
Sensitivity	0.00%	80.40%	79.80%
AUC	0.52	0.93	0.93

Notes: Due to a multicollinearity issue between a condition, existing drivers, and the interaction of the two, the interaction term was removed.

* $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Table S35

Descriptive and Mean Differences of Factors Provided by Condition, Chapter Five

	Video M (SD)	**Written *M* (SD)**	**Between-Groups Difference**
New Categories	1.75 (1.35)	1.67 (1.27)	$Z = 0.56$, $p = 0.58$
Existing Categories	0.92 (1.05)	1.02 (1.27)	$Z = -0.37$, $p = 0.71$
Methods	0.32 (0.57)	0.30 (0.61)	$Z = 0.78$, $p = 0.44$

Supplementary Table S36

Binomial Logistic Regression of Criminal Behavior on RCT and Other Deterrents and Drivers Interacted with Condition

Predictor	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)
Condition	0.86 (0.57, 1.30)	0.79 (0.43, 1.44)	0.89 (0.39, 2.02)
RCT Deterrents	-	0.41*** (0.27, 0.61)	0.38*** (0.25, 0.58)
RCT Drivers	-	8.53*** (4.30, 16.92)	8.52*** (4.21, 17.23)
Other Deterrents	-	0.42*** (0.28, 0.62)	0.28*** (0.25, 0.58)
Other Drivers	-	3.92*** (2.43, 6.32)	4.13*** (2.44, 6.99)
Condition* RCT Deterrents	-	-	0.84 (0.56, 1.30)
Condition* RCT Drivers	-	-	1.09 (0.54, 2.21)
Condition* Other Deterrents	-	-	0.65 (0.43, 1.00)
Condition* Other Drivers	-	-	1.15 (0.68, 1.94)
Intercept	0.90 (0.67, 1.20)	1.30 (0.79, 2.16)	1.22 (0.64, 2.34)
Deviance	494	265	260
AIC	498	277	280
χ^2 (df), *p*	(1) = 0.51	(5) = 230.05***	(9) = 234.54***
VIF (Range)	1.00	1.00 – 1.18	1.00 – 1.80
McFadden's R^2	0.00	0.47	0.47
Specificity	100%	93.40%	91.80%
Sensitivity	0.00%	69.90%	79.80%
AUC	0.52	0.91	0.92

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Table S37

Percentage of Participants that Indicated at least One Factor of a Category by Condition

Category	Video (%)	Written (%)	χ^2
Existing Categories	56%	57%	(1) = 0.02, *p* = 0.90
Legal Costs	15%	15%	(1) = 0.00, *p* = 1.00
Stigmatic Costs	10%	7%	(1) = 0.71, *p* = 0.40
Attachment Costs	2%	3%	(1) = 0.46, *p* = 0.50
Commitment Costs	0%	1%	(1) = 0.98, *p* = 0.32
Internal Future Emotions	0%	1%	(1) = 0.98, *p* = 0.32
Situational Costs	36%	30%	(1) = 1.17, *p* = 0.28
Morally Wrong	11%	16%	(1) = 2.01, *p* = 0.16
Situational Benefits	5%	9%	(1) = 3.22, *p* = 0.07
Enhanced Status	1%	1%	(1) = 0.00, *p* = 0.99
Sneaky Thrills	0%	0%	-
Internal Satisfaction	1%	0%	(1) = 1.03, *p* = 0.31
New Categories	80%	82%	(1) = 0.28, *p* = 0.60
Hitting a man with a bottle is too Aggressive	6%	9%	(1) = 1.22, *p* = 0.27
Unspecified Negative Outcomes	11%	9%	(1) = 1.25, *p* = 0.54
Deterring Benefits	4%	5%	(1) = 0.21, *p* = 0.38
Deterring Dispositions	25%	25%	(1) = 0.00, *p* = 0.99
Absence of a Benefit/No Cost	8%	7%	(1) = 0.22, *p* = 0.64
The Right/Best/Only thing to do	8%	6%	(1) = 0.79, *p* = 0.37
Deterring Behavior of Antagonist	6%	2%	(1) = 3.62, *p* = 0.06
Driving Stigma	8%	13%	(1) = 1.64, *p* = 0.20
Driving Situational Cost	7%	9%	(1) = 0.79, *p* = 0.37
Driving Dispositions	5%	5%	(1) = 0.03, *p* = 0.86
Retribution and Responsibility	8%	9%	(1) = 0.01, *p* = 0.92
Affect	9%	12%	(1) = 0.61, *p* = 0.44
Driving Behavior of the Antagonist	19%	13%	(1) = 2.40 *p* = 0.12
I Trust My Partner	2%	7%	(1) = 4.74, *p* = 0.03
Methods	27%	23%	(1) = 1.02, *p* = 0.31
Lisa Should Have Done More	10%	4%	(1) = 4.78, *p* = 0.03
"I Needed More Information"	3%	5%	(1) = 1.08, *p* = 0.30
Explicit Mention of Design	1%	1%	(1) = 0.00, *p* = 0.98
Cognitive Trade-off/Balancing Act	6%	6%	(1) = 0.03, *p* = 0.87
I Would Have *Not* Acted As The Protagonist Did	3%	3%	(1) = 0.00, *p* = 0.96
I Chose How I would have Acted in Real Life	1%	1%	(1) = 0.31, *p* = 0.58

Notes: The percentage displayed is the percentage of participants that indicated a minimum of one factor that fit within the respective category.

Supplementary Table S38

Logistic Regression of Non-criminal (0) and Criminal (1) Behavior

Predictor	Control OR (95%CI)	Depletion OR (95%CI)
Condition (Written)	Reference	
VR	1.60 (0.42, 6.19)	0.36 (0.10, 1.28)
Presence	1.04 (0.53, 2.02)	2.21* (1.14, 4.28)*
Realism	1.90 (1.01, 3.59)*	0.64 (0.35, 1.16)
Perceived Risk	0.36 (0.21, 0.64)***	0.81 (0.50, 1.32)
Positive Affect	0.89 (0.53, 1.52)	1.00 (0.61, 1.65)
Negative Affect	0.78 (0.39, 1.54)	0.72 (0.38, 1.37)
State Anger	1.92 (0.95, 3.86)	2.16 (1.09 4.30)*
Trait Aggressiveness	2.45 (1.38, 4.37)**	1.83 (1.06, 3.16)*
PANAS – Negative	1.08 (0.61, 1.89)	1.03 (0.61, 1.75)
PANAS – Positive	1.04 (0.63, 1.72)	0.89 (0.53, 1.48)
Constant	0.42 (0.24, 0.75)**	0.56 (0.34, 0.91)*
N	122	122
VIF (Range)	1.07 – 1.96	1.27 – 2.14
Likelihood Ratio χ^2 (df)	(10) = 47.00 ***	(10) = 31.80***
McFadden's R^2	0.29	0.20
Deviance	115	128
AIC	137	150
Sensitivity	65.20%	56.80%
Specificity	82.90%	87.20%
AUC	0.84	0.81

Notes: * $p < .05$; ** $p < .01$; *** $p < .001$

Supplementary Table S39

Comparison of Vignette Presentation (VR, Video, or Written) on Presence and Realism

Condition	Presence *M*	Δ*M* (95% CI)	Δ*M* (95% CI)	Realism *M*	Δ*M* (95% CI)	Δ*M* (95% CI)
VR (*N* = 23)	37.91	Reference		30.87	Reference	
Video (*N* = 177)	34.29	-3.62 * (-7.19, -0.57)	Reference	32.18	1.31 (-1.02, 4.53)	Reference
Written (*N* = 281)	30.95	-6.96 *** (-10.45, -3.47)	-3.33 *** (-4.88, -1.79)	30.88	0.01 (-3.14, 3.17)	-1.29 (-2.69, 0.10)

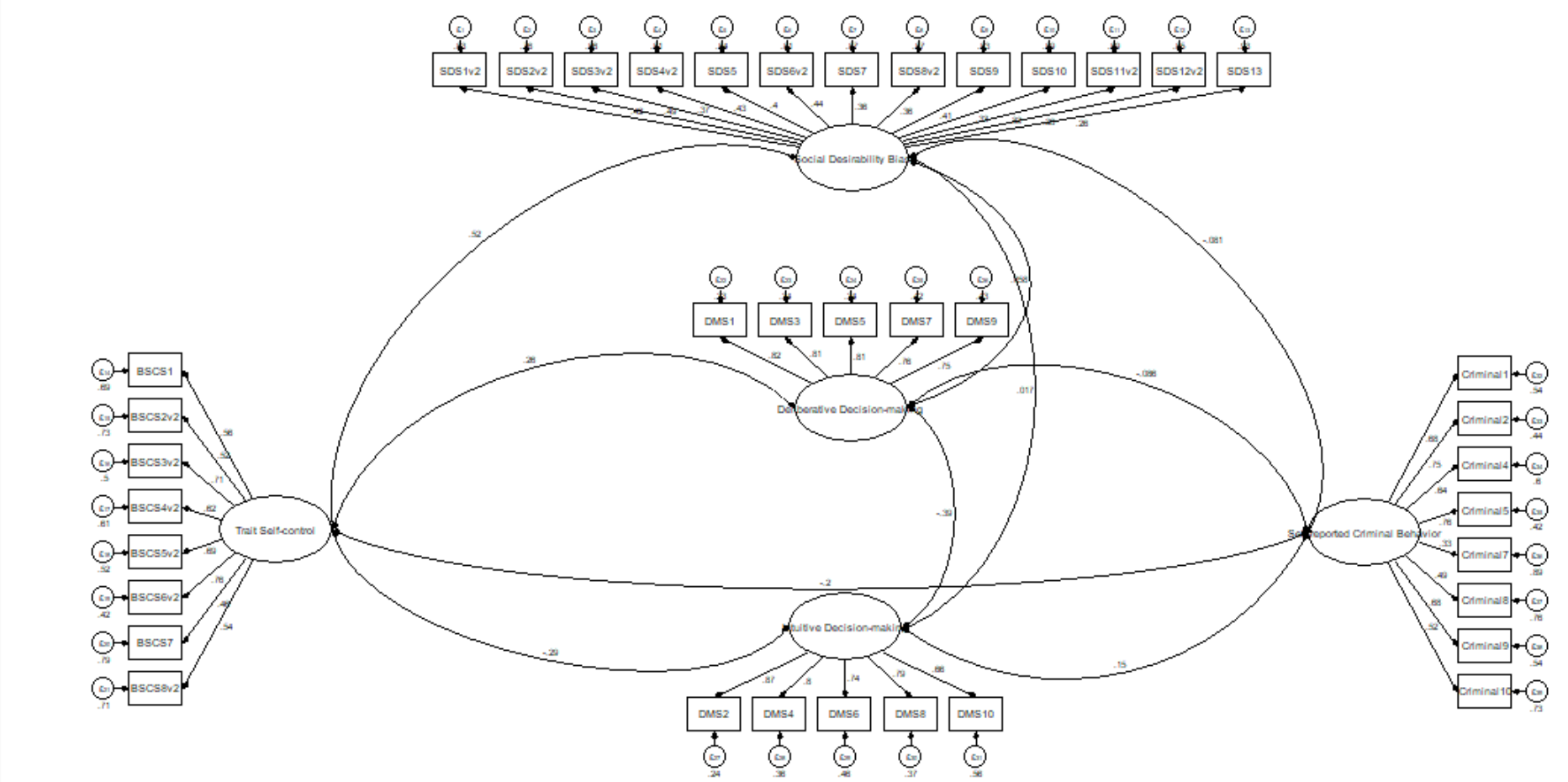
Notes: All means and differences in means presented are the estimated marginal means

* $p < .05$; ** $p < .01$; *** $p < .001$

Appendix E – Supplementary Figures

Supplementary Figure S1

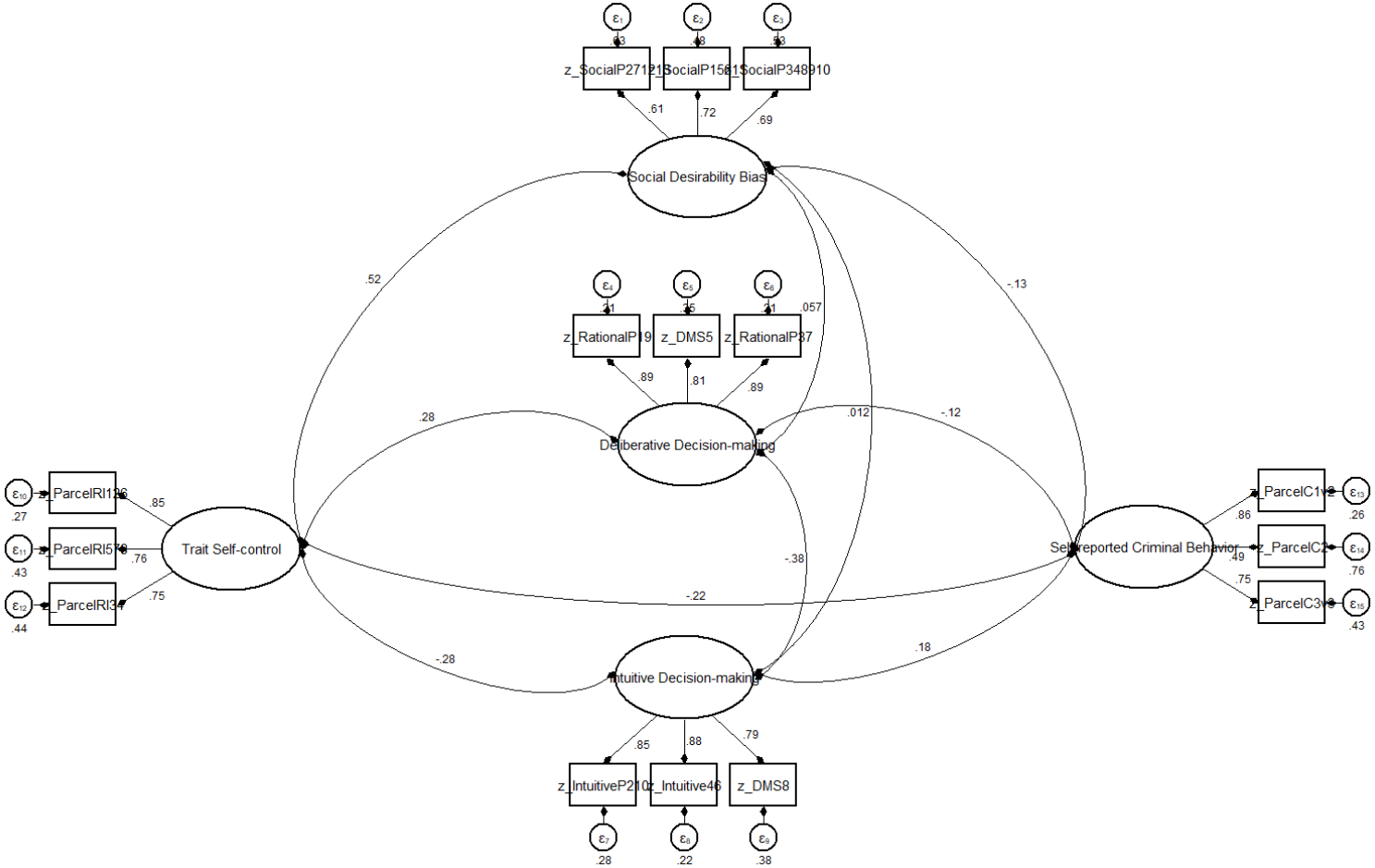
Confirmatory Factor Model of Decision-making Mediating Self-control and Self-reported Criminal Behavior with all observed indicators



Notes. Coefficients are standardized. Model fit: ($\chi^2(692) = 1523.759$, $p < 0.001$; RMSEA = 0.05, 90% CI [0.05, 0.05]; CFI = 0.86; TLI = 0.85; SRMR = 0.07).

Supplementary Figure S2

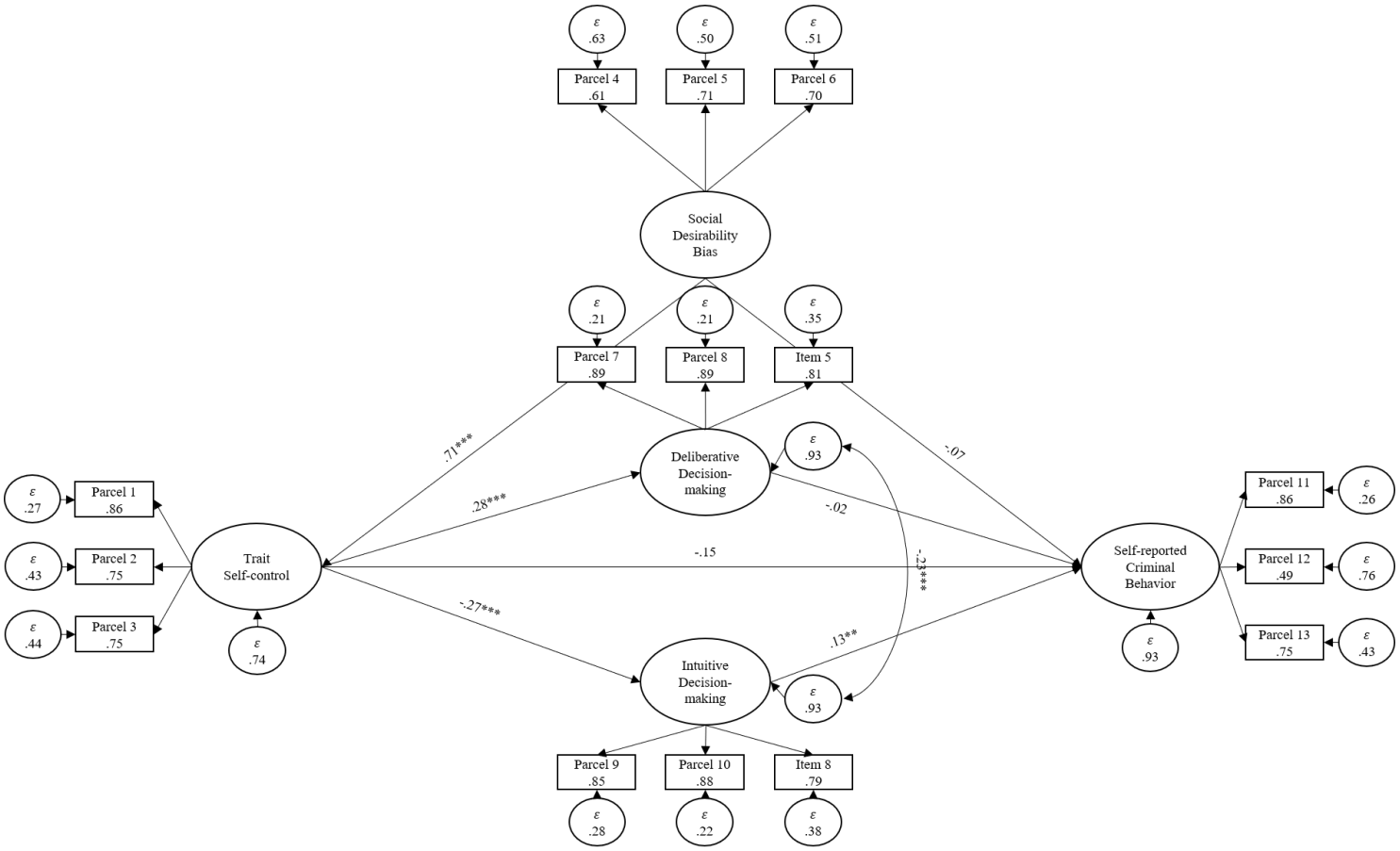
Confirmatory Factor Model of Decision-making Mediating Self-control and Self-reported Criminal Behavior with parceled indicators



Notes. Coefficients are standardized. Model fit: ($\chi^2(80) = 135.62$, $p < 0.001$; RMSEA = 0.04, 90% CI [0.03, 0.05]; CFI = 0.98; TLI = 0.98; SRMR = 0.04).

Supplementary Figure S3

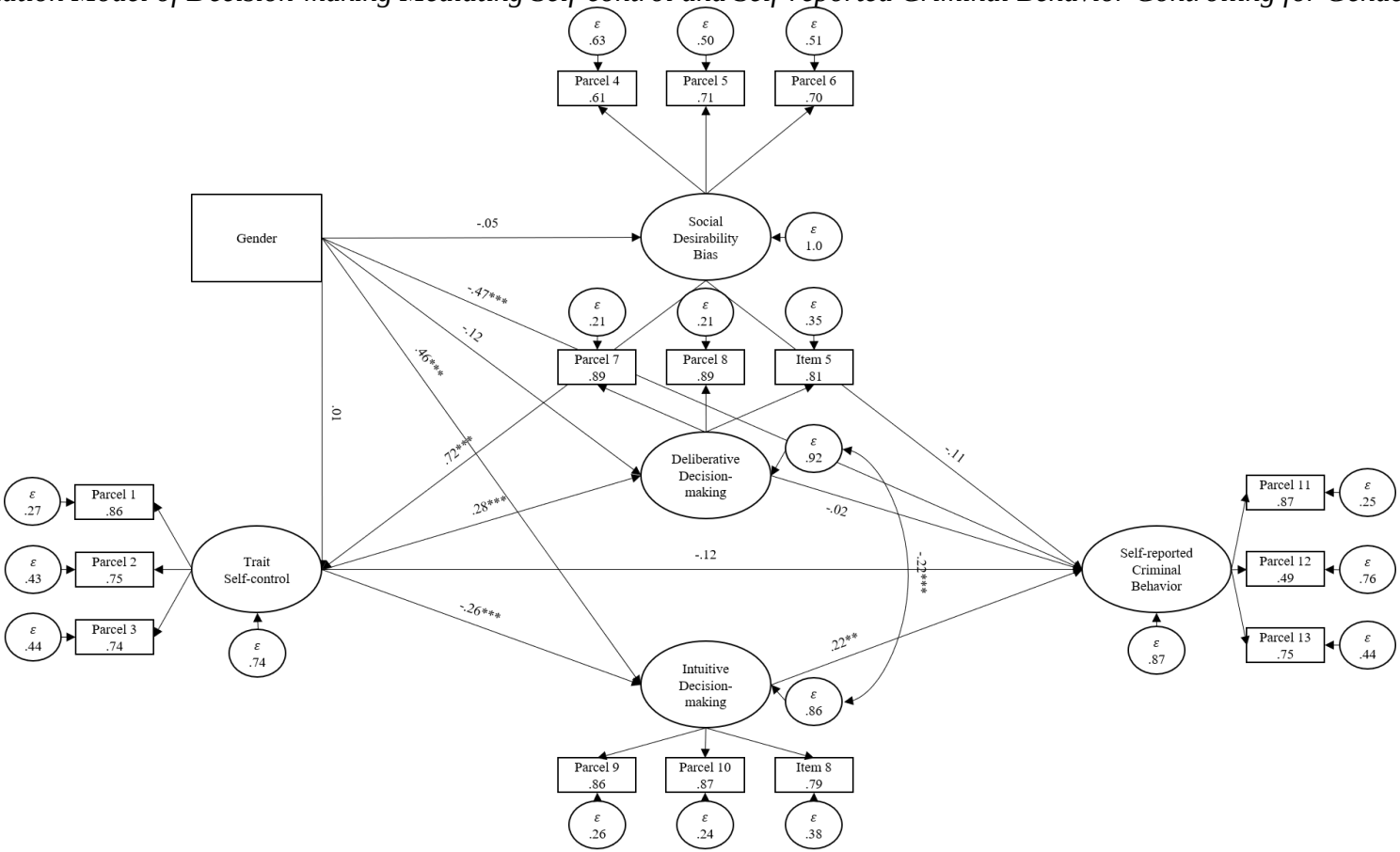
*Structural Equation Model of Decision-making Mediating Self-control and Self-reported Criminal Behavior with Parceled Indicators (*N *=476)*



Notes. Coefficients are standardized. The item construct of each parcel may be found in the notes of the Confirmatory Factor Analysis of each respective latent variable. Model fit: $\chi^2(82) = 146.03$, $p < .001$; RMSEA = .04, 90% CI: .03, .05; CFI = .98; TLI = .97.

Supplementary Figure S4

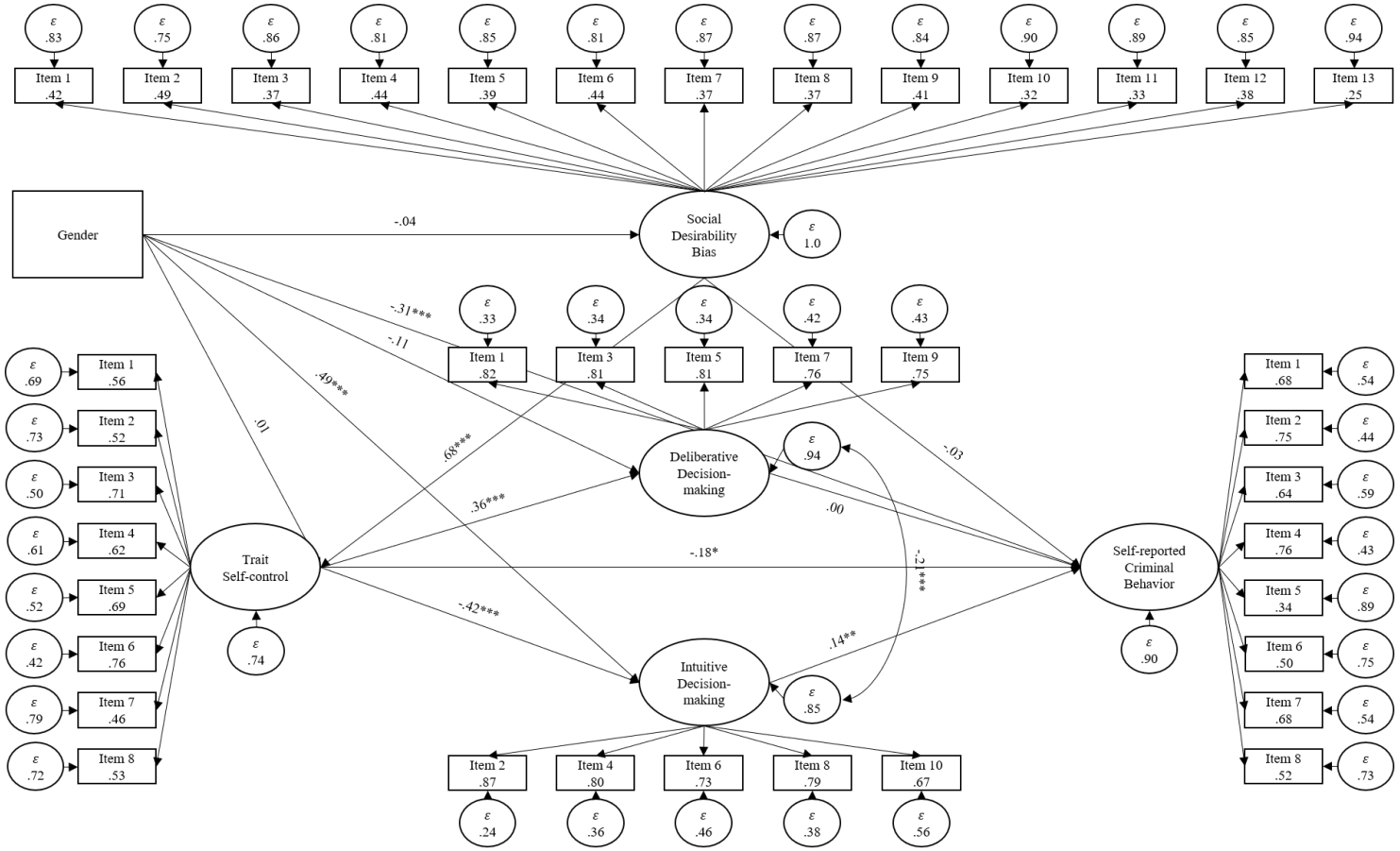
*Structural Equation Model of Decision-making Mediating Self-control and Self-reported Criminal Behavior Controlling for Gender (*N = *475)*



Notes. Coefficients are standardized. To create a dummy variable to control for Gender (1 = Male; 2 = Female), one participant indicating other was removed from analysis. Indicating a mediated model, self-control did not have a significant direct effect on self-reported criminal behavior (β = -.12, 95% CI [-.26, .03], *p* =.118), but did have a significant indirect negative effect (β = -.06, 95% CI [-.10, -.02], *p* = .005), for a total significant negative effect of trait self-control on self-reported criminal behavior (β = -.18, 95% CI [-.31, -.04], *p* = .011). Model fit: $\chi^2(92)$ = 162.33, *p* < .001; RMSEA = .04, 90% CI [.03, .05]; CFI = .98; TLI = .97.

Supplementary Figure S5

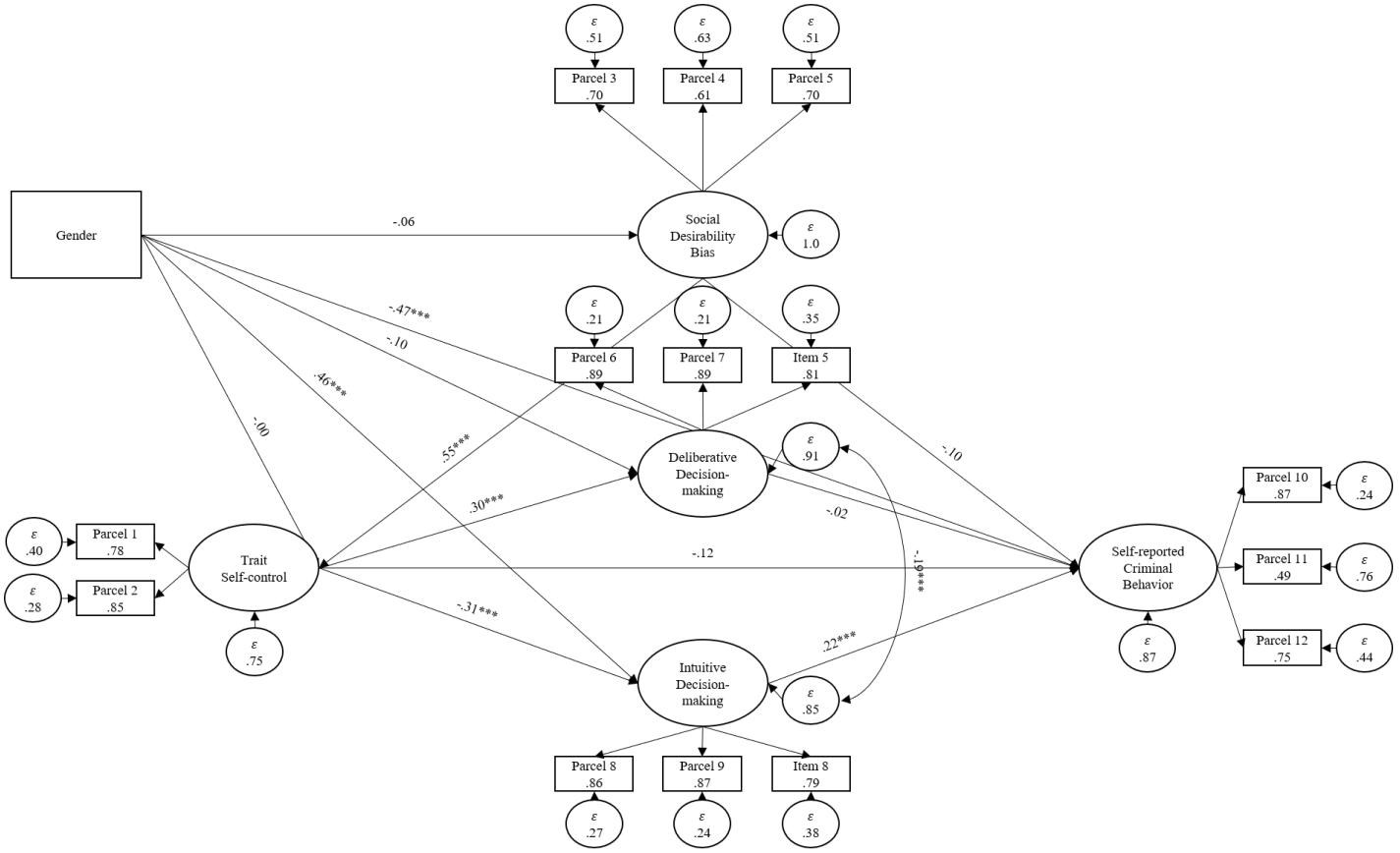
*Structural Equation Model of Decision-making Mediating Self-control and Self-reported Criminal Behavior Controlling for Gender (*N *= 475)*



Notes. Coefficients are standardized. To create a dummy variable to control for Gender (1 = Male; 2 = Female), one participant indicating other was removed from analysis. Indicating a mediated model, trait self-control had a significant direct (β = -.18, 95% CI [-.35, -.00], p = .045) and indirect effect on self-reported criminal behavior (β = -.06, 95% CI [-.10, -.01], p = .019) for a total significant negative effect of trait self-control on self-reported criminal behavior (β = -.24, 95% CI [-.40, -.07], p = .006). Model fit: $\chi^2(728) = 1622.15$, $p < 0.001$; RMSEA = 0.05, 90% CI [0.05, 0.05]; CFI = 0.85; TLI = 0.84.

Supplementary Figure S6

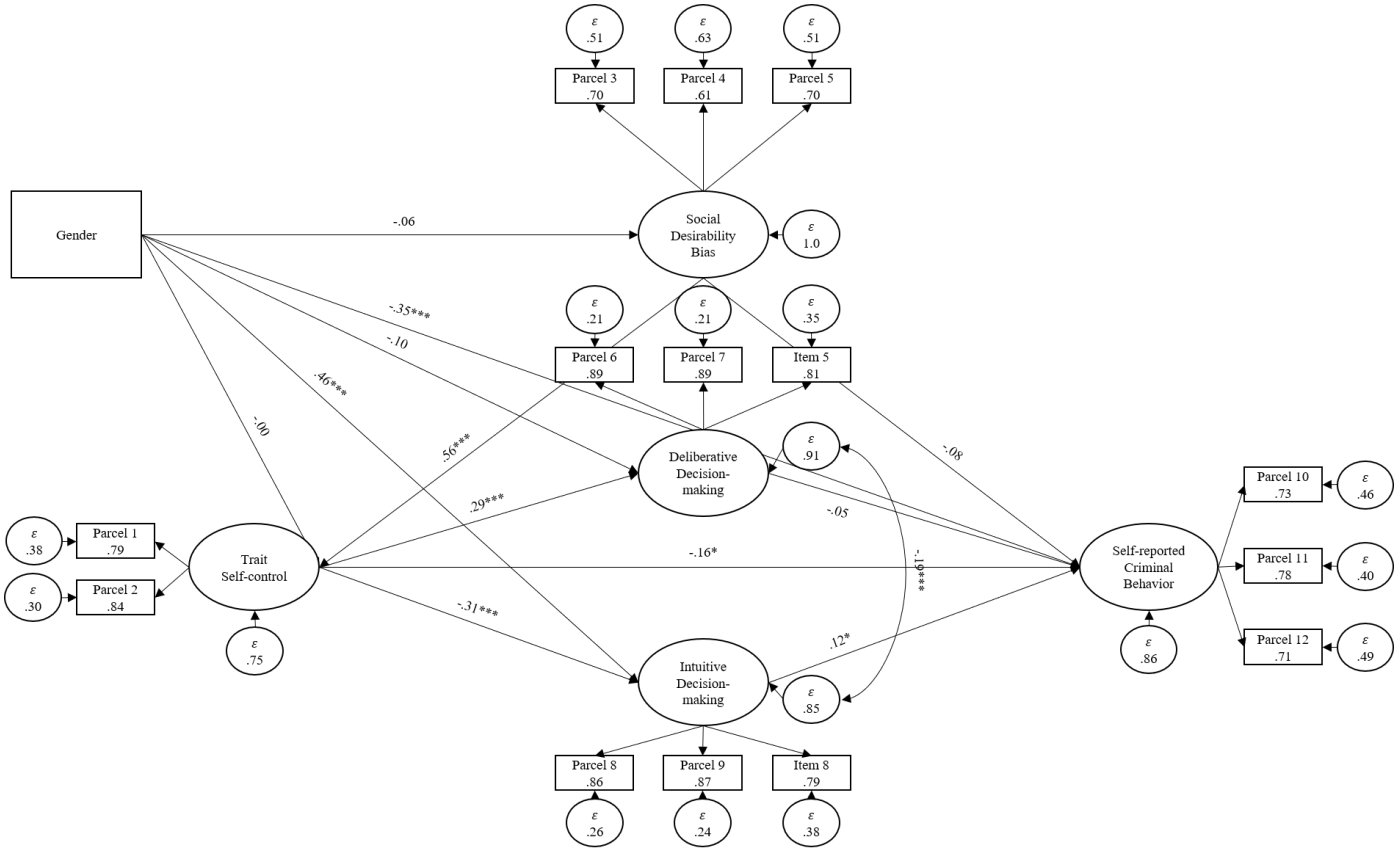
*Structural Equation Model of Decision-making Mediating Two Factor Self-control and Self-reported Criminal Behavior Controlling for Gender (*N *= 475)*



Notes. Coefficients are standardized. To create a dummy variable to control for Gender (1 = Male; 2 = Female), one participant indicating other was removed from analysis. Indicating a mediated model, trait self-control did not have a significant direct effect on self-reported criminal behavior (β = -.12, 95% CI [-.29, .04], p = .147), but did have a significant indirect effect on self-reported criminal behavior (β = -.07, 95% CI [-.12, -.02], p = .006) for a total significant negative effect of trait self-control on self-reported criminal behavior (β = -.19, 95% CI [-.35, -.04], p = .013). Model fit: $\chi^2(78) = 142.10$, $p < .001$; RMSEA = .04, 90% CI [.03, .05]; CFI = .98; TLI = .97.

Supplementary Figure S7

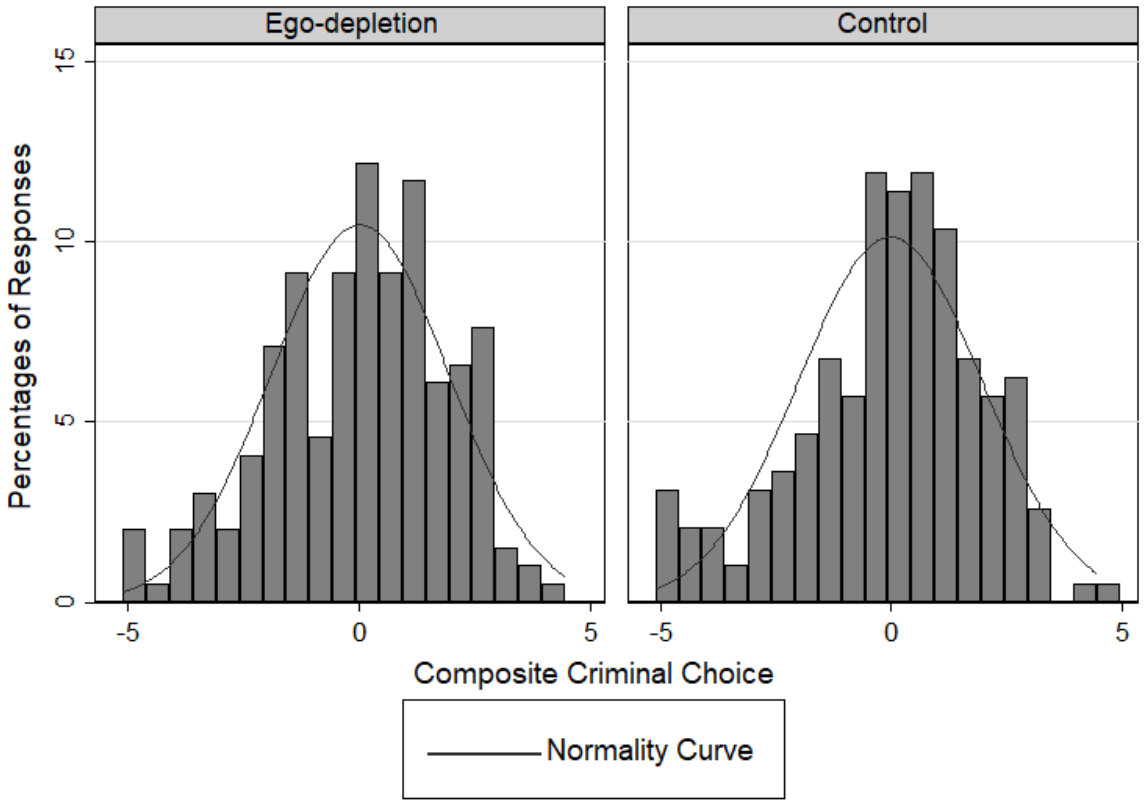
*Structural Equation Model of Decision-making Mediating Two Factor Self-control and Variety Scale Self-reported Criminal Behavior Controlling for Gender (*N = *475)*



Notes. Coefficients are standardized. To create a dummy variable to control for Gender (1 = Male; 2 = Female), one participant indicating other was removed from analysis. Indicating a mediated model, trait self-control had a significant direct (β = -.16, 95% CI [-.30, -.02], p = .024) and indirect effect on self-reported criminal behavior (β = -.05, 95% CI [-.09, -.01], p = .011) for a total significant negative effect of trait self-control on self-reported criminal behavior (β = -.22, 95% CI [-.35, -.08], p = .001). Model fit: $\chi^2(78) = 128.81$, $p < .001$; RMSEA = .04, 90% CI [.03, .05]; CFI = .98; TLI = .98.

Supplementary Figure S8

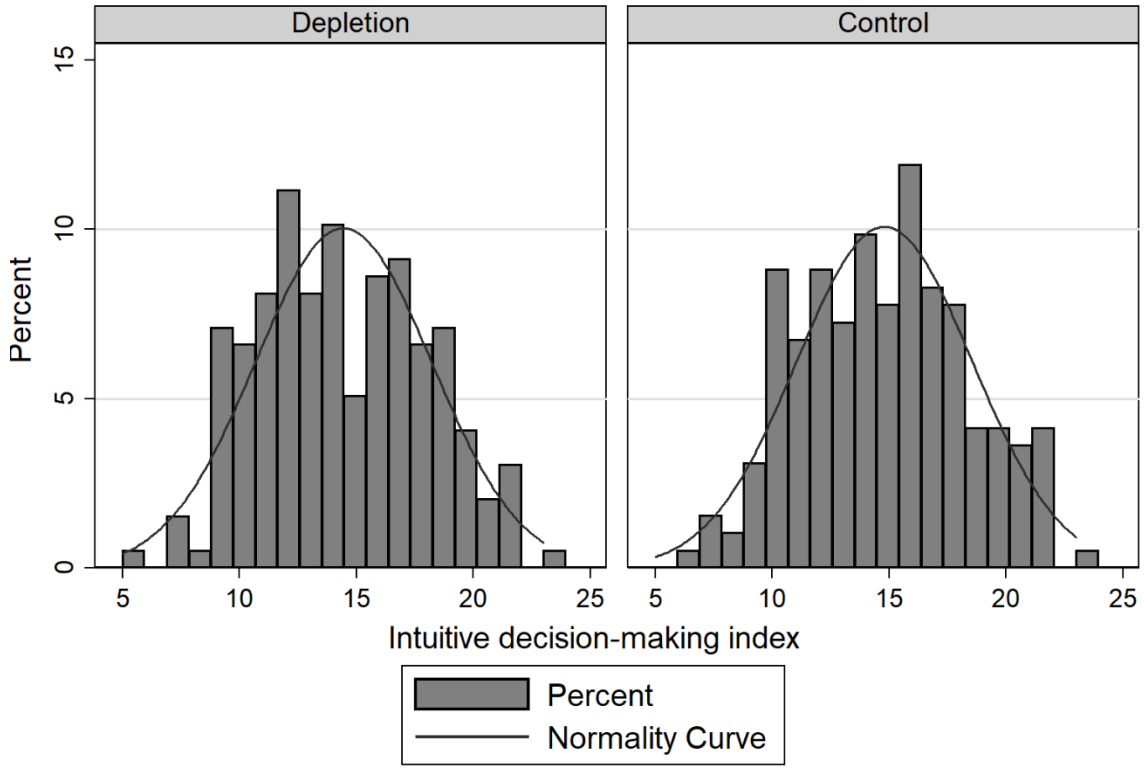
Histogram of Criminal Choice by Condition



Notes. To adjust for the smaller sample size of each condition, an adjusted Jarque-Bera Test was used to assess normality, which uses a bootstrapping procedure to develop a χ^2 statistic. For the ego-depletion group, the data was normally distributed (χ^2 (2) = 5.84, p = 0.05); while for the control group the statistic suggest that the data is not normally distributed (χ^2 (2) = 8.15, p = 0.02). However, this particular normality test is sensitive and over-penalizes for violations of normality. As such, taking into account both the histogram and the adjusted Jarque-Bera Test, I argue that the data is reasonably, normally distributed.

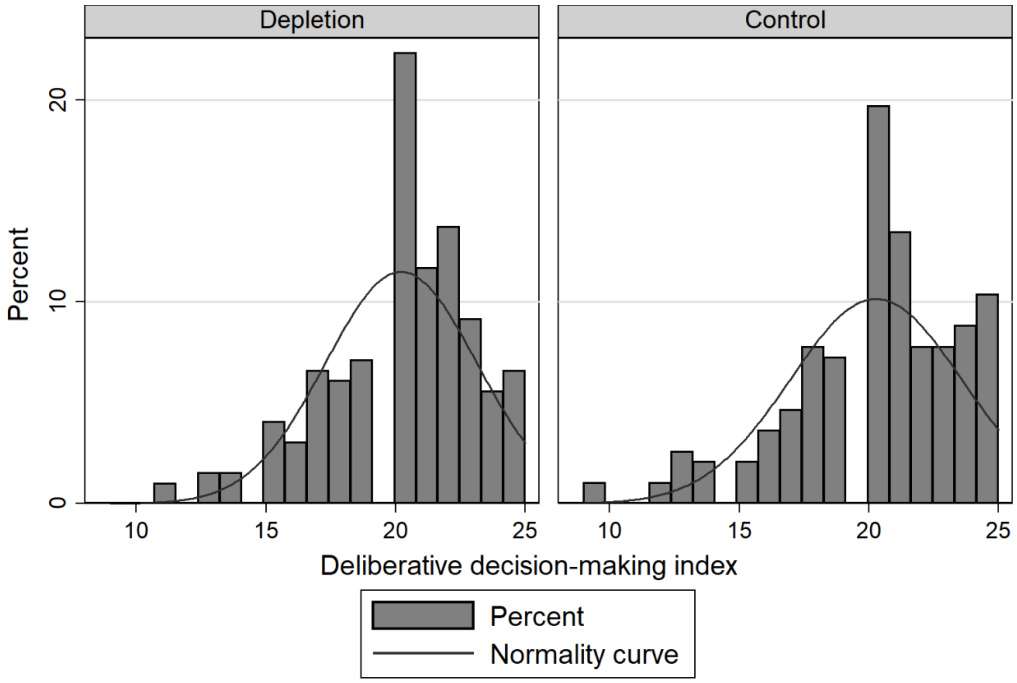
Supplementary Figure S9A

Histogram of Intuitive Decision-making by Condition, Chapter Three



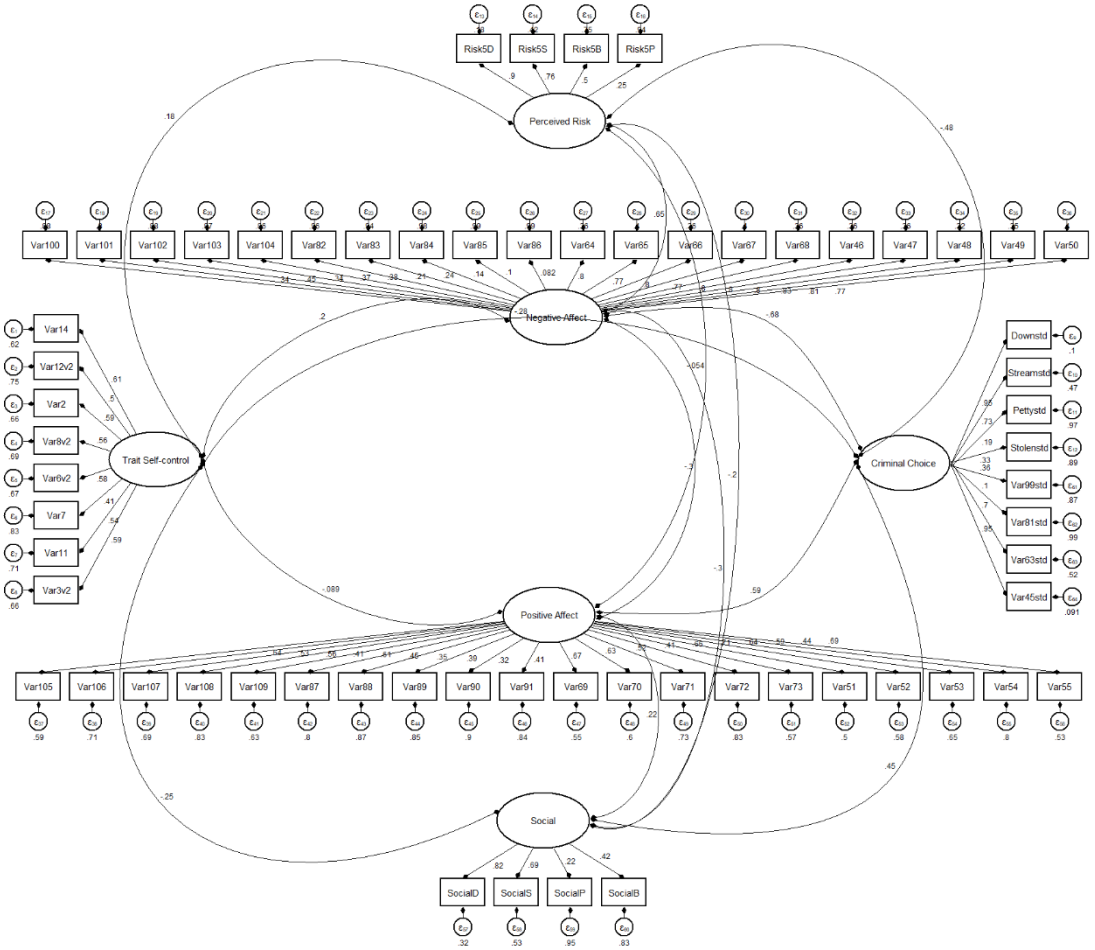
Supplementary Figure S9B

Histogram of Deliberative Decision-making by Condition, Chapter Three



Supplementary Figure S10

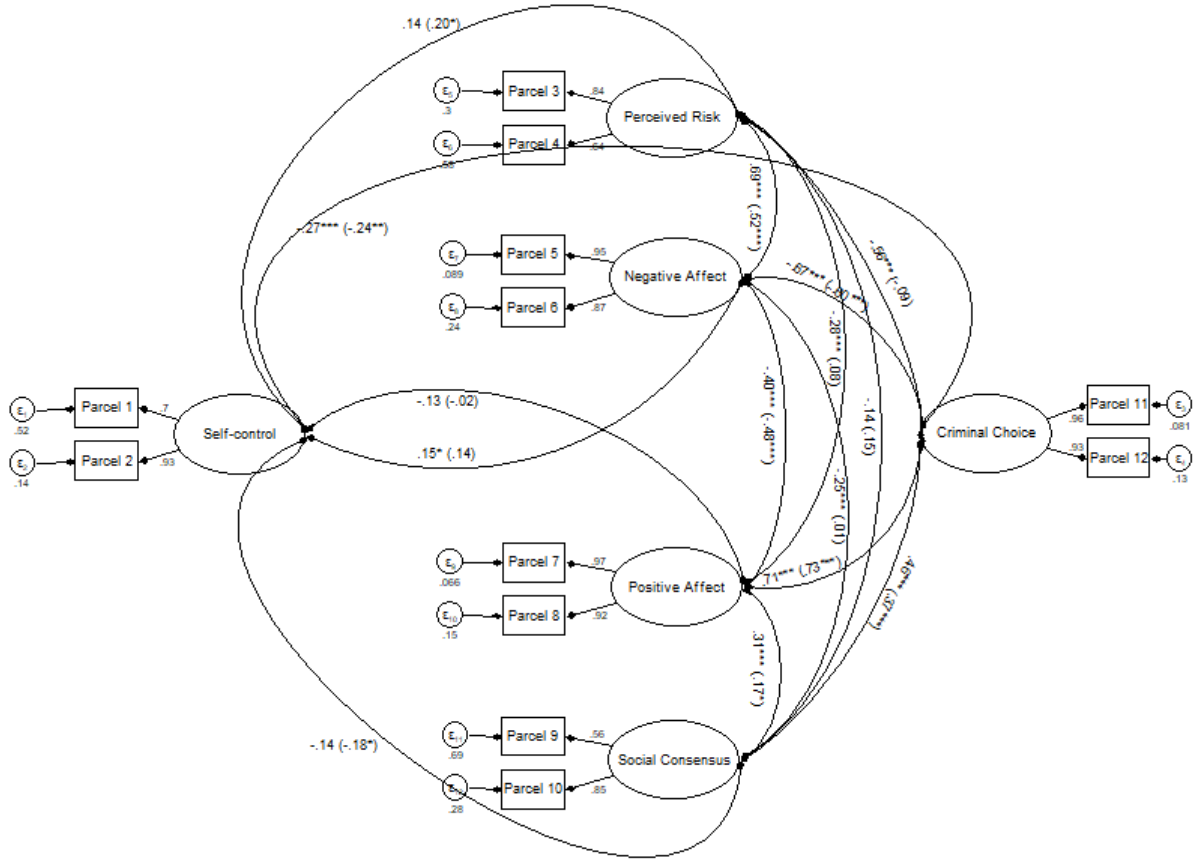
CFA Between Groups Mediation Model of Perceived Risk, Negative Affect, Positive Affect, and Social Consensus on Criminal Choice with all Parameters Constrained to be Equal



Notes. Model Fit: χ^2 (4081) = 13786.962, RMSEA = 0.11 95% CI [0.11, 0.12], CFI = 0.46, TLI = 0.46, SRMR = 0.15

Supplementary Figure S11

Between Groups CFA of Perceived Risk, Negative Affect, Positive Affect, and Social Consensus on Criminal Choice with Parceled Indicator Loadings and Correlations



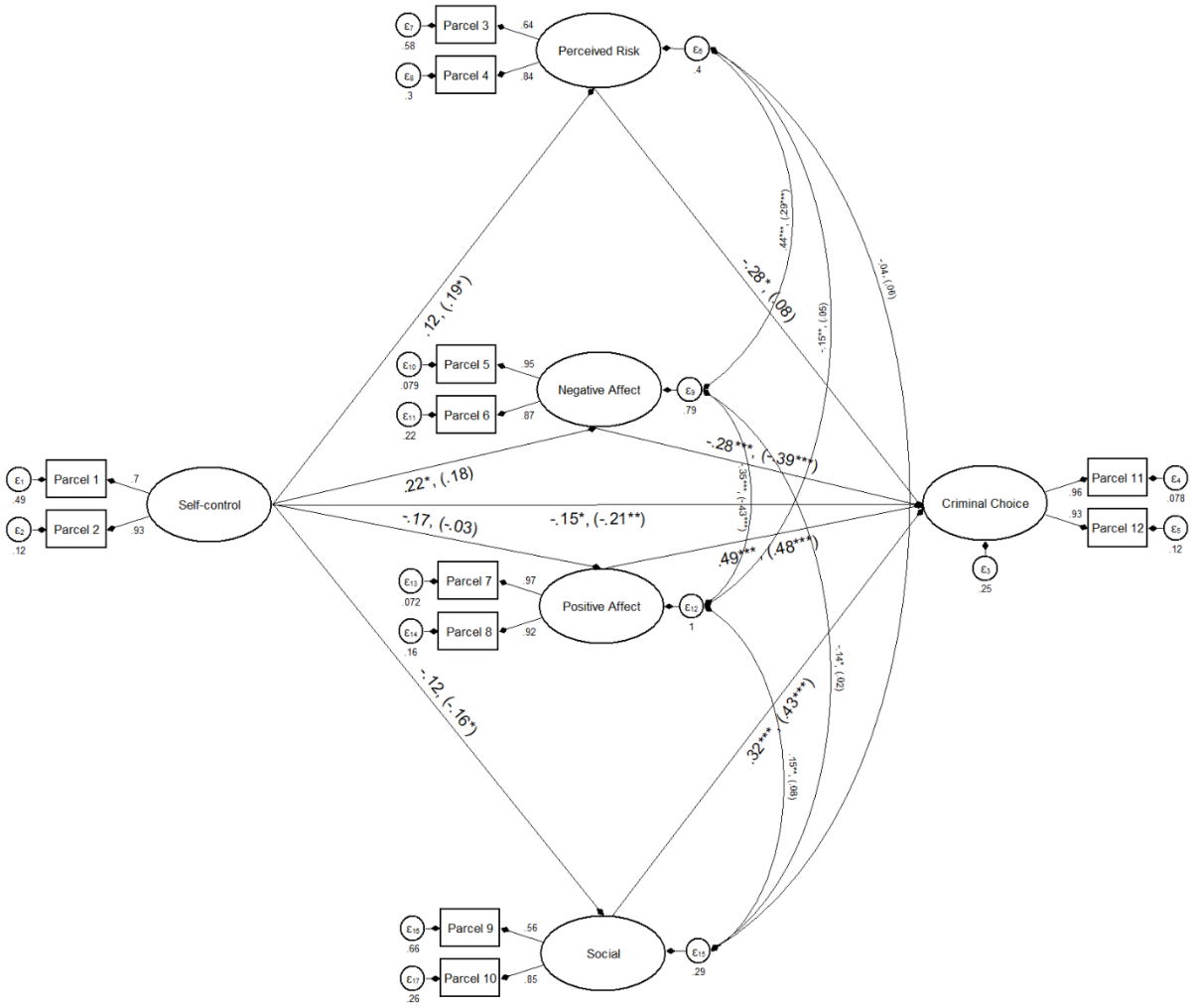
Note. The depletion groups coefficients are presented in the parentheses. The presented coefficients are standardized. For a description of which items are placed in which parcels, please see Appendix F; Supplementary Text S3. Model fit: Model fit: χ^2 (108) = 235.355, p <.001; RMSEA = .08, 90% CI [.06, .09]; CFI = .95; SRMR = .04)

*≤ .05 , ** $p \leq .01$, *** $p \leq .001$ [105].

[105]Please note, while I present standardized measurement loadings and error terms, they are not perfectly the same across groups (varying by approximately .01). For standardized coefficients to be the same, each variable must have equal standard deviations across the groups, which is typically not the case. See, Acock, 2013, Box 5.1, pg. 227-228) for a detailed explanation.

Supplementary Figure S12

Between Groups Mediation Model of Perceived Risk, Negative Affect, Positive Affect, and Social Consensus on Criminal Choice with Observed Indicator Loadings and Correlations

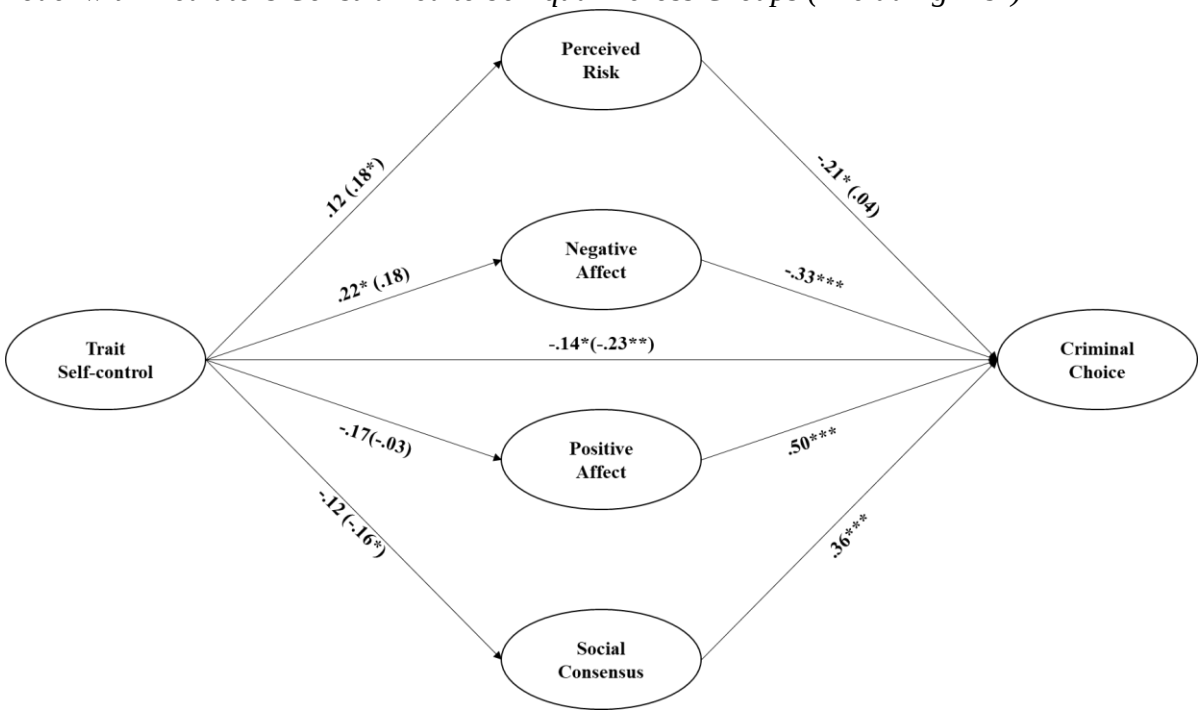


Notes. The depletion groups coefficients are presented in the parentheses. The presented coefficients are standardized. For a description of which items are placed in which parcels, please see Appendix F; Supplementary Text S3. Model fit: χ^2 (108) = 235.355, p <.001; RMSEA = .08, 90% CI [.06, .09]; CFI = .95; SRMR = .04; $R^2_{\text{criminal choice}}$ = .75 (Control); .72 (Depletion). * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$ [106].

[106]Please note, while I present standardized measurement loadings and error terms, they are not perfectly the same across groups (varying by approximately .01). For standardized coefficients to be the same, each variable must have equal standard deviations across the groups, which is typically not the case. See, Acock, 2013, (Box 5.1, pg. 227-228) for a detailed explanation.

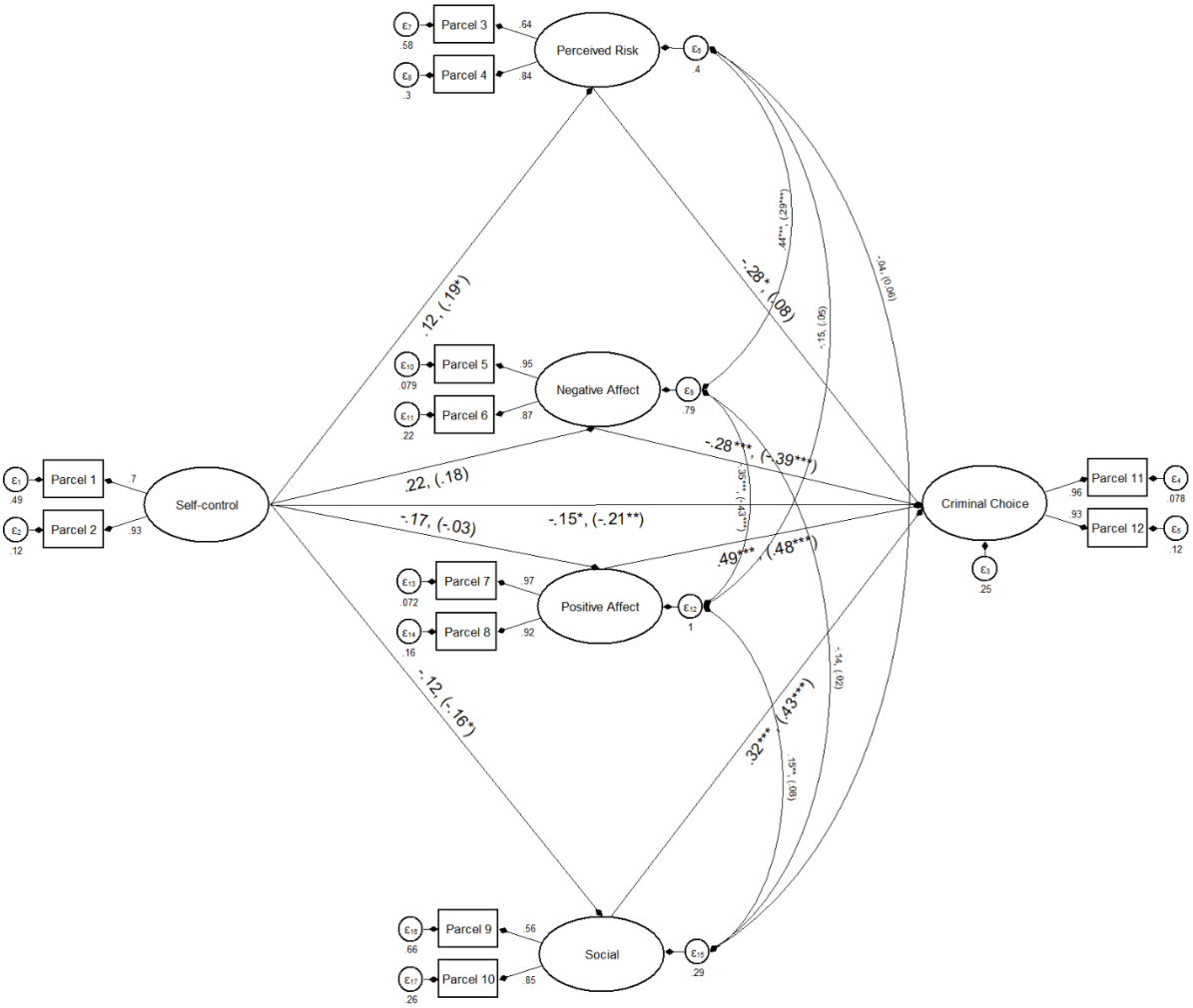
Supplementary Figure S13

Model with Mediators Constrained to be Equal Across Groups (Excluding Risk)



Supplementary Figure S14

Between Groups Mediation Model of Perceived Risk, Negative Affect, Positive Affect, and Social Consensus on Criminal Choice with a Robust Estimator.

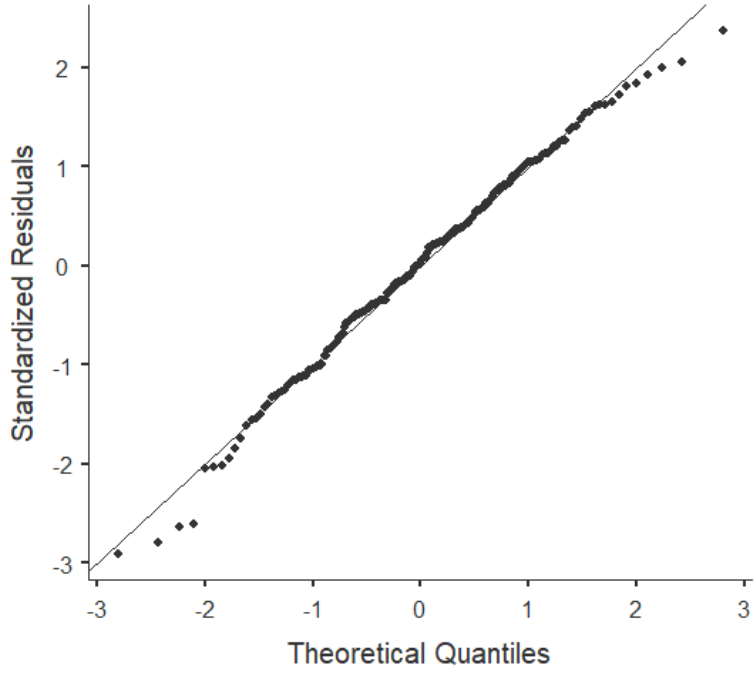


Notes. As standard fit statistics are not available with a robust estimator, I provide the SRMR (.04) which is identical to the main model presented in text. $R^2_{\text{criminal choice}}$ = .75 (Control); .72 (Depletion). The depletion groups coefficients are presented in the parentheses. The presented coefficients are standardized. The only notable differences include paths and correlations no longer being significant in the control group not related to the hypotheses assessed. Specifically, the path from self-control to negative affect, the correlation between risk and positive affect, as well as the correlation between negative affect and perceived social consensus. For a description of which items are placed in which parcels, please see Appendix F; Supplementary Text S3. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$ [107].

[107]Please note, while I present standardized measurement loadings and error terms, they are not perfectly the same across groups (varying by approximately .01). For standardized coefficients to be the same, each variable must have equal standard deviations across the groups, which is typically not the case. See, Acock, 2013, Box 5.1, pg. 227-228) for a detailed explanation.

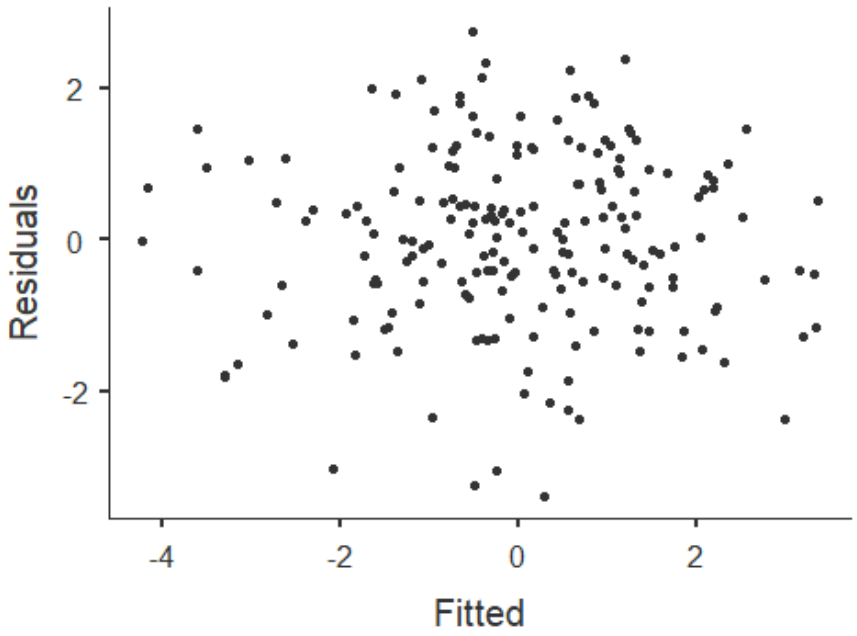
Supplementary Figure S15

Q-Q Plot of Standardized Residuals for the Regression of Criminal Choice, Depletion Group



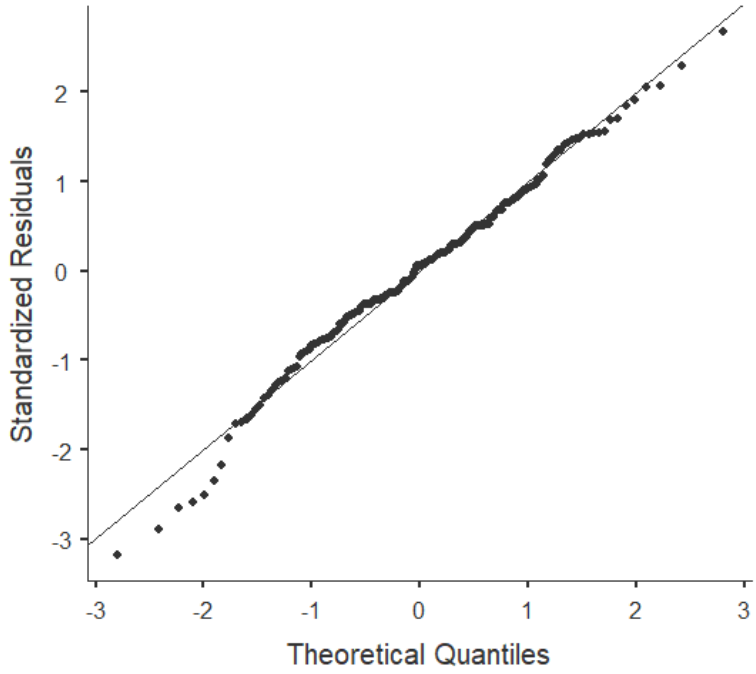
Supplementary Figure S16

Residuals Plot for the Regression of Criminal Choice, Depletion Group



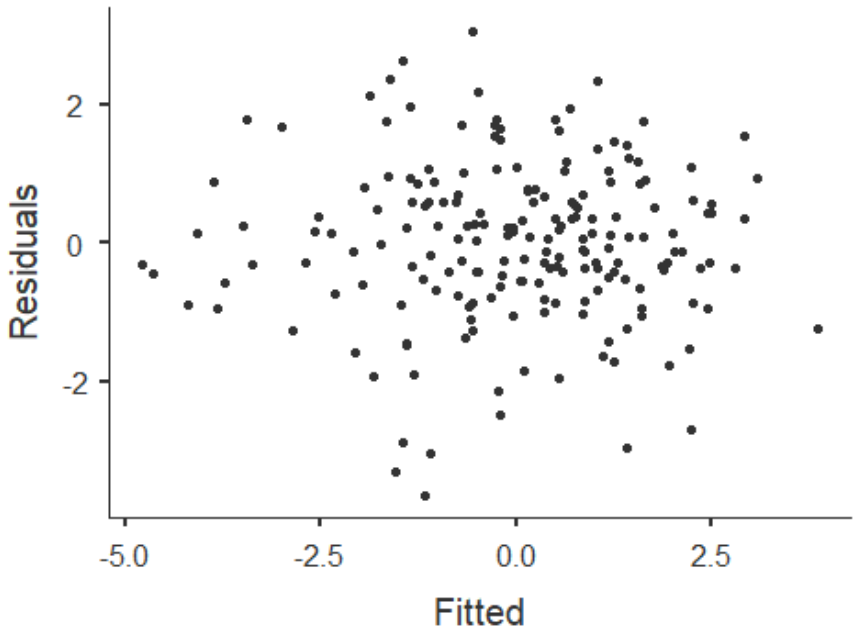
Supplementary Figure S17

Q-Q Plot of Standardized Residuals for the Regression of Criminal Choice, Control Group



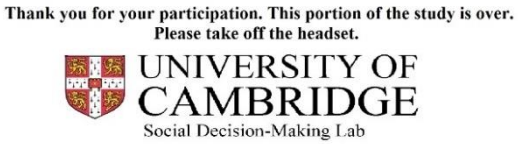
Supplementary Figure S18

Residuals Plot for the Regression of Criminal Choice, Depletion Group



Supplementary Figure S19

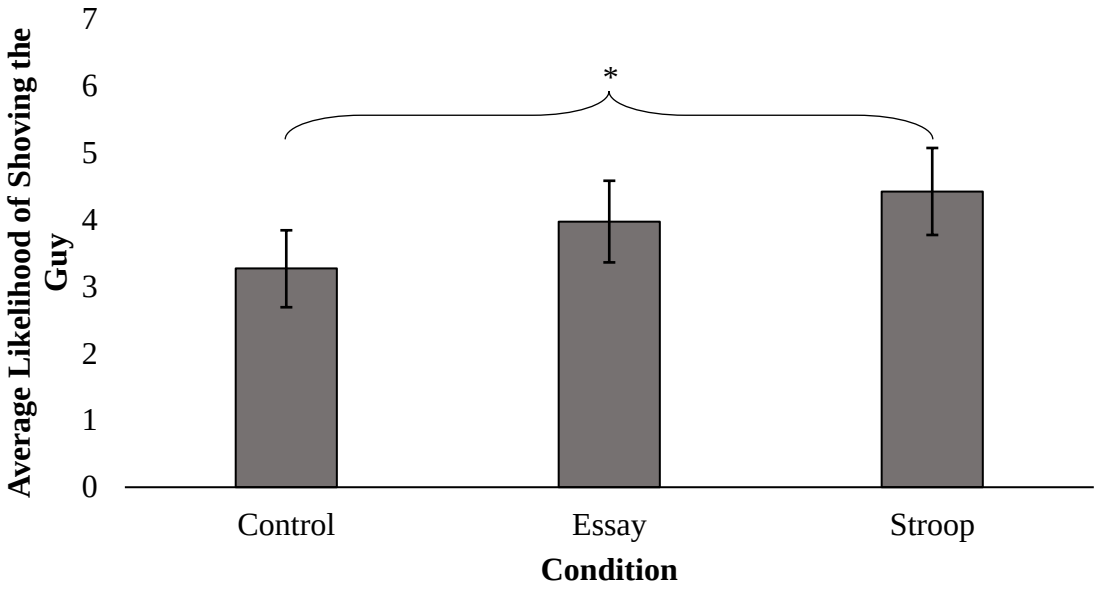
Concluding image



Notes. The concluding image was presented to participants within the HTC Vive Headset to indicate the testing had been completed.

Supplementary Figure S20

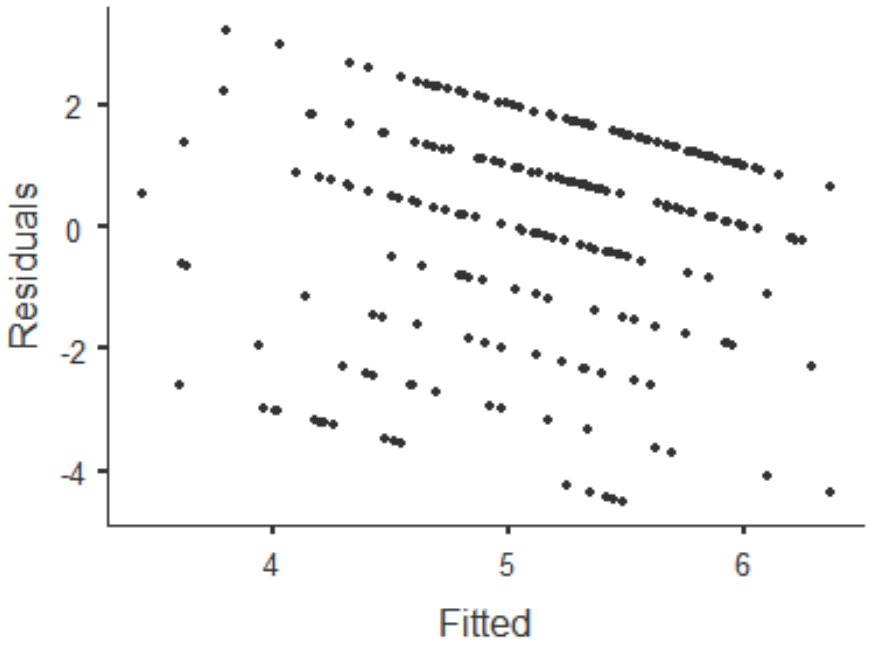
Likelihood of Shoving the Guy by Stroop and Control Conditions, Pilot-test



Notes. Participants indicated the likelihood of shoving the guy on a 1 to 7 Likert scale.

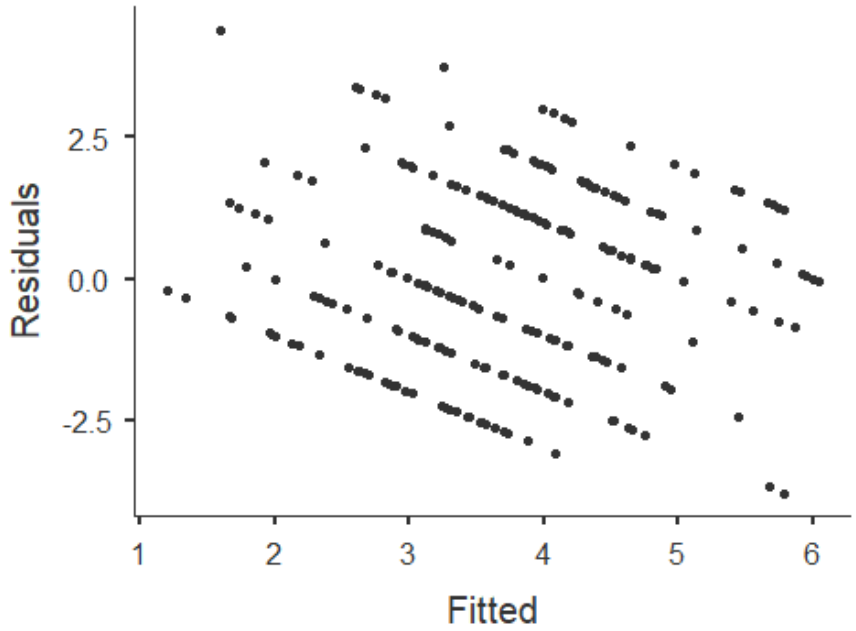
Supplementary Figure S21

Residuals Plot for Homoscedasticity, Model 4 of 'Just Walk Away', Chapter Four



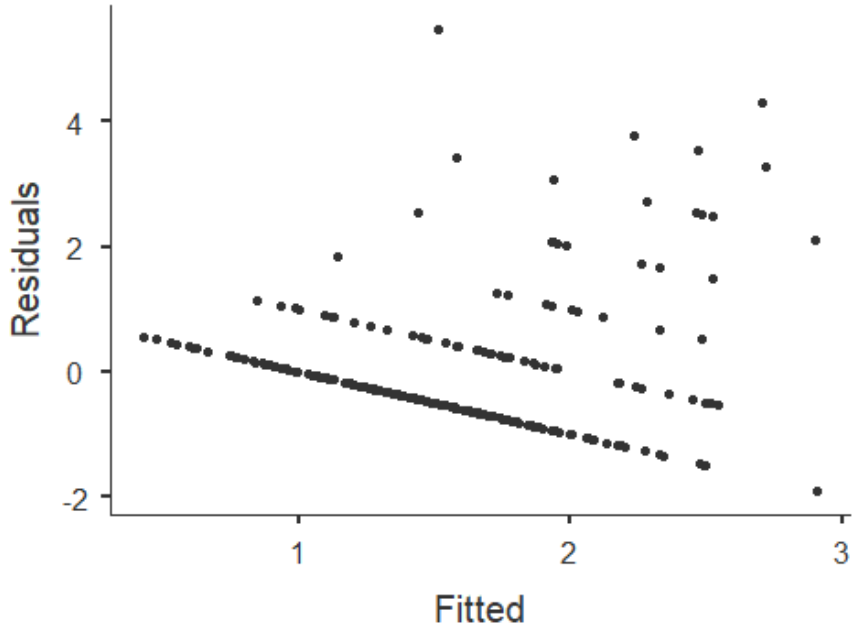
Supplementary Figure S22

Residuals Plot for Homoscedasticity, Model 4 of 'Shove the Guy', Chapter Four



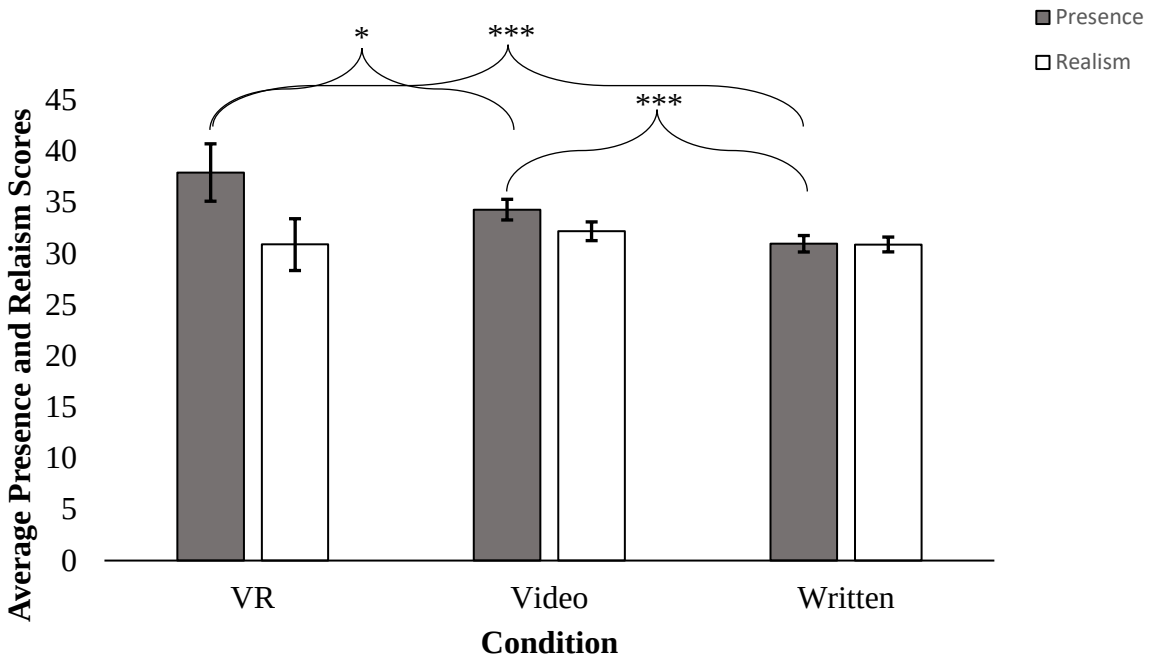
Supplementary Figure S23

Residuals Plot for Homoscedasticity, Model 4 of 'Hit the Guy with a Bottle', Chapter Four



Supplementary Figure S24

Average Presence and Realism Scores by Condition Across Chapters Four and Five



Appendix F – Supplementary Text

Supplementary Text 1 – Data Quality Check, Chapter Three

The raw text data was analyzed in Microsoft Excel.

Character length was assessed with the code: "=LEN(Cell1)+LEN(Cell2)".

Nonsensical text was determined with the code:
"=IF(ISBLANK(Cell1),COUNT(SEARCH(REPT({"a","b","c","d","e","f","g","h","i","j","k","l","m","n","o","p","q","r","s","t","u","v","w","x","y","z",0,1,2,3,4,5,6,7,8,9},3),Cell1))>0,COUNT(SEARCH(REPT({"a","b","c","d","e","f","g","h","i","j","k","l","m","n","o","p","q","r","s","t","u","v","w","x","y","z",0,1,2,3,4,5,6,7,8,9},3),AQ35))>0)".

If which if a character was repeated 3 times without a space (e.g., aaa) the code returned a "true" value and the input was manually checked for quality. Two participants returned a 'true' value for nonsensical text, but upon manual inspection this was due to a spelling error (i.e., 'goood') and a filler spot due to the nature of the task (i.e., xxx).

Supplementary Text 2 - Pilot-test Amendments, Chapter Three

The original ego-depletion task conducted in the pilot-test instructed participations to write about a recent trip that they had taken for approximately three minutes. Once three minutes had passed, the "continue survey" button would appear to allow them to click and progress. Through analyzing the pilot-test data it was found that there was a large range of page submissions times ([~ $3.5_{minutes}$, $20_{minutes}$], $M = 5.66_{minutes}$, $SD = 4.15_{minutes}$). The increased time in the ego-depletion (or control) could potentially undermine the goal of the depletion task. That is, there was no way of determining if any time past the prompted three minutes was used by actively engaging in the task. As such, any extra time not spent engaging in the task could serve as a "cooling-off" period, negating the effects of the ego-depletion task. While there is no way to confirm it, I believe the extra time was due to the fact that the "continue survey" button appeared in a lower section of the screen. This would have required participants to scroll down after approximately three minutes to find and then click the "continue survey" button. To circumnavigate any potential "cooling-off" period as the result of participants being unable to see the "continue survey" button, the survey was changed to increase the time required from three to four minutes, and to automatically continue after four minutes to the next page.

Supplementary Text S3 – Parcel Creation, Chapter Three

Parcel 1 contain items 1, 7, 11, and 13, while parcel 2 contains items 2, 5, 6, and 10, of the brief self-control scale (Tangney et al., 2004) as described by Maloney and colleagues (2012). Parcel 3 contains the perceived risk items from the buying stolen goods and illegal streaming scenario while parcel 4 contains the perceived risk items from the illegal downloading and petty theft scenario (see methods section for perceived risk item creation). Parcel 5 and 6 contain 10 items each. Parcel 5 contains 4, 1, 2, and 3 negative affect items from the illegal downloading, streaming, buying stolen goods, and petty theft scenarios, respectively. Parcel 6 contains 1, 4, 3, and 2 negative affect items from the illegal downloading, streaming, buying stolen goods, and petty theft scenarios, respectively. Parcels 7 and 8 contain 10 items each. Parcel 7 contains 3, 2, 3, and 2 positive affect items from the illegal downloading,

streaming, buying stolen goods, and petty theft scenarios, respectively. Parcel 8 contains 2, 3, 2, and 3 items from the illegal downloading, streaming, buying stolen goods, and petty theft scenarios, respectively. Parcel 9 contains the social consensus items from the illegal downloading and petty theft scenarios, while parcel 10 contains the social consensus items from the illegal streaming and buying stolen goods scenarios. Finally, parcel 11 contains the percentage estimate item of criminal choice from each scenario while parcel 12 contains the multiplicative item of criminal choice from each scenario (see methods section for multiplicative item creation).

Supplementary Text S4 – Pilot-test, Chapter Four

To determine which ego-depletion task would have the greatest effect on the outcome variable of criminal choice, a pilot-test was conducted with 120 participants in total. Three conditions were used in the pilot-test, Control (N = 45), an Essay Depletion group (N = 37), and a Stroop Depletion group (N = 38). All participants were recruited from Prolific Academic (Peer et al., 2017) and were paid £0.50 in compensation. The outcome of variable of interest was the mean difference between groups of the likelihood of walking away, shoving the guy, or hitting the guy with the bottle as Likert Items (1-7). As the outcome variables are suspected to relate to one another, a Multivariate Analysis of Variance (MANOVA) was used.

When examining the assumptions of a MANOVA: the variables held a linear relationship with one another (Appendix D, Supplementary Table S10) and there was homogeneity of variance-covariance matrices across the groups (Box F (12, 62222.4) = 1.48, p = 0.1239; Box χ^2 (12) = 17.74, p =0.1238). Due to the nature of the outcome variables (aggressive/criminal) and small sample size within each group the multivariate normality assumption was violated, however most combinations of conditionXoutcome variable were well within the general guidelines of less than 2.0 for skewness and less than 7.0 kurtosis (Appendix D, Supplementary Table S11).There was a statistically significant difference between condition on the combined dependent variables (Wilks' Lambda = F(6,230) = 2.30, p = .04; Appendix D, Supplementary Table S12). Follow-up analysis revealed that compared to participants in the control group, participants that went through the Stroop task were more likely to shove the guy (M_{stroop} = 4.42 vs. $M_{control}$ = 3.27, M_{diff} = 1.15, SE = 0.42, 95%CI [0.16, 2.15]; *Tukey* T = 2.75 p = 0.019; Appendix E; Supplementary Figure S20), while participants in the essay task were not (M_{Essay} = 3.97, M_{diff} = 0.71, SE = 0.42, 95%CI [-0.30, 1.71]; *Tukey* T = 1.67 p =.221).