JURORS’ USE OF GENETIC AND ENVIRONMENTAL EVIDENCE AS
MITIGATION IN DEATH PENALTY TRIALS

by

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Thesis directed by Professor Edie Greene

Recent research has found evidence that the low-activity \textit{MAOA} gene and history of child maltreatment make people more likely to commit violent, criminal acts. Given the wide discretion defense attorneys have in presenting evidence as mitigation during death penalty cases, it is probable that this specific genetic-environmental (G X E) interaction may be brought into the courtroom as mitigation in the near future. In a 2 X 4 between-subjects factorial design that varied the likelihood of the defendant’s future dangerousness (Low or High) and explanations of the defendant’s behavior (Control, Environmental, Genetic, or G X E), participants were exposed to evidence from a capital murder trial, rendered individual verdicts, and then deliberated as a jury to reach a unanimous decision to sentence the defendant to death or life imprisonment without the possibility of parole. The main hypothesis was that the G X E – Low Dangerousness conditions would render the fewest death sentences and results supported this hypothesis.

\textit{Key words}: MAOA, child maltreatment, G X E interaction, future dangerousness, death penalty case, jury decision-making
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CHAPTER 1
INTRODUCTION

Imagine that you are called for jury duty and find that you will be serving as a juror in a criminal trial where the defendant has been convicted of first-degree murder, and the prosecution is seeking the death penalty. Next, imagine that you and your fellow jurors have unanimously found the defendant guilty, and must now decide if he will be sentenced to death or life imprisonment. The prosecution presents evidence regarding the defendant’s risk of future dangerousness and other factors supporting a sentence of death. But then the defense tells you that the defendant had a terrible childhood where he was abused both sexually and physically by his father, and that he carries a gene that has been found to, in combination with a history of child maltreatment, make people more likely to commit violent, criminal acts. Would you feel that the defendant is less responsible? Would you feel that he is less deserving of the death penalty because he was influenced by factors beyond his control? Or would you say he still deserves to die?

These are the questions jurors may soon be faced with in capital trials. These are the questions I wanted to learn the answer to.

The ultimate form of punishment in the American legal system is the death penalty, which is currently allowed in 31 states (DPIC Fact Sheet, 2016). As of January
1, 2016, there are 2,943 inmates on death row (DPIC Fact Sheet, 2016), all of whom were sentenced by laypeople acting as jurors.

Thus, it is jurors who are responsible for making the ultimate decision in a capital trial: whether someone will live or die. They are able to consider a wide range of factors in making this decision, including the defendant’s mental illness, history of child abuse or maltreatment, and poverty. Recently, new forms of evidence have been introduced during the sentencing phase of capital trials to aid jurors in their decision-making process—specifically, biological evidence, including neuroimagery and genetics. Soon, it may be the case that defense attorneys will use a combination of nature and nurture—now termed a genetic by environmental interaction (G X E interaction)—to explain the defendant’s behavior.

In this paper, I describe the results of a study examining how a specific G X E interaction might function to mitigate sentencing during the penalty phase of capital trials. Research has found that individuals with the low-activity \textit{MAOA} gene and a history of child maltreatment are predisposed to violent, criminal behavior, and defense attorneys have asked to have this evidence admitted in capital trials to help jurors understand why the offender may have committed the crime. My study examines the possible impact of this evidence on mock jurors.
CHAPTER II

REVIEW OF THE LITERATURE

Capital Trials: The Guilt and Penalty Phase

A capital murder trial is comprised of two phases: guilt and penalty. The guilt phase, as in other criminal trials, involves the prosecution using the available evidence to attempt to prove beyond a reasonable doubt that the defendant committed the murder. The jury must be unanimous in their decision to find the defendant guilty.

The evidence presented in the guilt phase helps the jury in determining whether or not the defendant committed the alleged murder. Such evidence may include facts of the case, physical evidence, evidence of a mental disability, testimony of witnesses who saw the murder, and any other factors related to how the murder happened. If the defendant has a mental disability, for example, the defense may argue that the defendant is Not Guilty By Reason of Insanity (NGRI) or Guilty But Mentally Ill (GBMI).

In the penalty phase, the jury bears the responsibility of deciding whether the defendant will be sentenced to death or life imprisonment. In most states, the jury must be unanimous in their decision to sentence the defendant to death. The hope is that jurors will reflect the conscience and values of the community (Costanzo, 1997). Unfortunately, there are a number of problems that come with jurors making these decisions.
Potential Biases in Juror Decision-Making

For one, jurors have little experience in sentencing decisions or clear-cut beliefs about who is deserving of the death penalty (Costanzo, 1997). Furthermore, because prospective jurors have had little direct experience with the criminal justice system, most of them enter the courtroom with their knowledge of a trial based on what they learn from the media, which holds questionable accuracy and is even less relevant to capital trials (Sandys, Pruss, & Walsh, 2010). For example, while jurors may be aware that their task in the guilt phase of a capital trial is one of determining criminal responsibility as a group, they may not learn that their task changes in the penalty phase to one of deciding the appropriate punishment for the defendant based on the defendant’s moral culpability, and that they must make this decision by themselves, not as a whole (Sandys et al., 2010). This distinction in tasks can be difficult for jurors to appreciate, thereby undermining the relevance of the mitigation (evidence presented in favor of a sentence of life imprisonment) presented to them (Sandys et al., 2010).

Research also suggests that jurors do not have a good understanding of the terms that are most important in making sentencing decisions—namely, aggravating factors (those which support a sentence of death) and mitigating factors (previously mentioned). For example, Haney and Lynch (1994) presented judicial instructions used in capital cases to college students three times and found that only 8% were able to provide legally correct definitions of aggravation and mitigation, 7% provided responses that were entirely incorrect, and 3% were unable to even guess at a response. This adds to the notion that jurors may not understand the evidence presented as either mitigation or aggravation as intended by law (Sandys et al., 2010).
Even if jurors are able to understand the evidence presented to them as either mitigation or aggravation, research has found that jurors have difficulty understanding judges’ pattern penalty phase instructions. For example, jurors have misconceptions about a) when it is appropriate to use mitigating factors that are not explicitly mentioned (e.g., remorse) b) the burden of proof required for mitigating factors, and c) how to appropriately weigh aggravating and mitigating factors (Blankenship et al., 1997). Otto, Applegate, and Davis (2007) presented participants with Florida’s pattern penalty phase instructions either alone or accompanied by clarifications of these three common misunderstandings. They found that participants were better able to understand instructions that were accompanied by clarifications, concluding that jurors, and the system of capital punishment as a whole, would benefit from the addition of such clarifications to judges’ instructions (Otto et al., 2007).

Research has also indicated that if a capital trial proceeds to the penalty phase, nearly half of the jury has already made up their minds about the penalty even though they were instructed not to (Sandys et al., 2010). Bowers and Foglia (2003) interviewed former capital jurors as part of the Capital Jury Project and found that only 50.8% remained undecided on what the penalty should be after they had found the defendant guilty but prior to hearing any evidence or argument regarding what the penalty should be; 30.3% favored a death sentence at this stage; and 18.9% favored a sentence of life imprisonment. Consequently, defense attorneys are faced with trying to convince an already biased audience to vote for life imprisonment.

A final issue arises as a result of a process required during the stage of *voir dire* (Mitchell & Byrne, 1973), or jury selection, in a capital trial, known as death
qualification. Death qualification is the process of filtering out potential jurors who might be unfair or biased towards either the prosecution or the defense because of pre-existing attitudes about the death penalty (Devine, 2012). Jury studies from the late 1990s and on have shown that jurors who are more supportive of the death penalty are more likely to convict (Nietzel, McCarthy, & Kerr, 1999; Allen, Mabry, & McKelton, 1998), and simply going through the process of death-qualification itself appears to make all jurors somewhat more likely to convict (Cox & Tanford, 1989; Nietzel, Dillehay, & Himelein, 1987). Furthermore, Butler and Moran (2007) found that jurors who were more supportive of the death penalty were more susceptible to the influence of negative pretrial publicity against a well-known, real-life defendant and were more likely to believe he was deserving of the death penalty.

Ultimately, jurors’ inexperience in making sentencing decisions, their inability to fully understand legal terminology, their difficulty following judge’s instructions, and their susceptibility to bias make attorneys’ and judges’ jobs even more difficult. Additionally, because the jury selection process eliminates any prospective juror who is unwilling to impose a death sentence, jurors chosen specifically for death penalty cases tend to be more conviction-prone, giving defense attorneys an even greater challenge. Therefore, attorneys and judges must attempt to help jurors through the decision-making process by giving clear, thorough explanations of the evidence so the defendant in a capital trial can receive the fair trial he (or she) deserves. The evidence in the penalty phase of a capital trial is comprised of both mitigating and aggravating factors.
Aggravation and Mitigation

Defined

As mentioned earlier, the evidence in the penalty phase of a capital trial focuses on mitigating and aggravating factors. Mitigating factors are defined in Black’s Law Dictionary (1983) as those that “do not constitute a justification or excuse of the offense in question but which, in fairness and mercy, may be considered as extenuating or reducing the degree of moral culpability” (p. 519). Thus, the purpose of mitigation is to lessen the penalty in light of the circumstances and also to explain the homicidal act; it does not condone the defendant’s behavior or excuse the crime itself.

Aggravating factors, on the other hand, aim to increase the defendant’s moral culpability. To seek the death penalty, the prosecution must provide at least one aggravating factor (Giorgi-Guarnieri et al., 2002). A jury may only sentence the defendant to death if aggravating factors outweigh mitigating factors (Costanzo, 1997).

Jurors are guided by mitigating and aggravating factors in deciding whether the defendant is deserving of the death penalty. Therefore, it is important to mention the various types of evidence that are presented as either mitigation or aggravation by the defense and prosecution, respectively, during the penalty phase of a capital trial, and to explain why such evidence might make the defendant appear more or less culpable.

Examples: Aggravating Factors

The prosecution’s role in a capital trial is to dehumanize the defendant through the presentation of aggravating factors and the defense attorney’s role is to humanize the defendant by presenting a plausible explanation for his behavior through the presentation of mitigating factors (Costanzo, 1997). Research suggests that the prosecution may in fact
have an advantage over the defense. Apparently, capital jurors are predisposed to endorse aggravators (Butler & Moran, 2002) and to believe that aggravation requires a sentence of death (Bentele & Bowers, 2001), therefore making them more likely to sentence the defendant to death.

The Federal Death Penalty Statute contains an overarching list of aggravating and mitigating factors for jurors to consider, and states that currently allow the death penalty have used some or all of these categories (Edersheim, Brendel, & Price, 2012). One of the most powerful aggravating factors is the defendant’s future dangerousness (Sandys et al., 2010).

**Future dangerousness.** The prosecution may use an expert witness to influence jurors’ perceptions of the defendant’s future dangerousness (Sandys et al., 2010). Research by Krauss and Sales (2001) has found that expert testimony emphasizing future dangerousness of the defendant increases mock jurors’ ratings of dangerousness. However, expert testimony regarding the defendant’s risk of future dangerousness is a highly controversial topic in the mental health field due to the questionable legitimacy of such testimony and the accuracy of such predictions (Cunningham & Reidy, 1999, 2002).

For example, Reidy, Cunningham, and Sorenson (2001) summarized the research findings of incidents of violent prison misconduct among former death row inmates in the general prison population. Over a number of follow-up periods ranging from 2 to 53 years across multiple jurisdictions, the rates of assault in the prison population by death row, former death row, capital life, LWOP (life without parole), and LWP (life with parole) inmates were relatively low, ranging from 0-31% (Reidy et al., 2001). These low base rates suggest there is difficulty in determining exactly which capital defendants will
go on to commit acts of violence in the future without also identifying a large number of false positives (Edens, Buffington-Vollum, Keilin, Roskamp, & Anthony, 2005).

Furthermore, expert testimony of future dangerousness has been denounced by some professional organizations (e.g., American Psychiatric Association, 1983; American Psychological Association Task Force, 1978), although it is still regularly introduced during the penalty phase of capital trials (Cunningham & Reidy, 2002; Edens, 2001; Edens, Petrila, & Buffington-Vollum, 2001).

Allegations of future dangerousness can be used in one of three ways: (a) as a statutory aggravator, (b) as a non-statutory aggravator, and (c) as a rebuttal to defense claims that the defendant lacks future dangerousness (Sandys et al., 2010). Statutory aggravators are factors specified by legislators whereas non-statutory aggravators are not specified in such a way (Palmer, 1998). A death sentence cannot be imposed on the basis of non-statutory aggravators alone; however it can be imposed on the finding of at least one statutory aggravator (Palmer, 1998).

In Oregon and Texas, discussion of violence risk is required in order for jurors to impose a sentence of death (Edens et al., 2005). But even in jurisdictions where future dangerousness is not listed as an aggravator for jurors to consider, research has found that it is still central to jurors’ decision-making process (Blume, Garvey, & Johnson, 2001). Research from the Capital Jury Project, funded by the National Science Foundation, suggests that jurors spend a significant amount of time during deliberation discussing the defendant’s risk of future dangerousness, which they often infer to be high from the defendant’s lack of remorse, perceived brutality of the crime, and defendant’s questionable mental capacities (Garvey, 1998). When a defendant is perceived as
dangerous, jurors will be more likely to vote for a sentence of death (Garvey, 1998; Eisenberg et al., 1998).

Alternatively, if the defendant is not perceived as dangerous, he is more likely to be perceived as remorseful and jurors will be more likely to vote for a sentence of life imprisonment (Garvey, 1998; Eisenberg et al., 1998). Accordingly, a lack of future dangerousness may actually function to mitigate sentencing, though it is not quite as powerful (Sandys et al., 2010). The defense may argue that the defendant lacks future dangerousness due to an absent criminal history and/or perceptions that the defendant would behave well in prison (Sandys et al., 2010).

Despite the weight jurors place on the defendant’s future dangerousness, research has found that jurors’ determinations of the defendant’s risk of future dangerousness are not very accurate. A study conducted by Marquart, Ekland-Olson, and Sorenson (1989) compared the institutional behavior of death row inmates in Texas who had their sentences either commuted or reversed with capital murderers sentenced to life imprisonment. Juries determined that the first group had a higher probability of criminal acts of violence that suggested a continued threat to society, whereas they did not find the second group to hold such risk. These groups were also compared to the entire general prison population in 1986 and a population of inmates housed in single high-security prison. Marquart et al. (1989) found that the former death row inmates had engaged in a lower rate of assaultive institutional misconduct than the comparison groups—specifically, 1/5 the rate of the general population and 1/10 the rate of the high-security prison population.
Other aggravating factors. Examples of more implicit aggravating factors include the defendant’s lack of remorse, the viciousness of the crime, multiple victims, the age of the victim(s), the defendant’s mental capacities, and psychopathy (Sandys et al., 2010). However, their utility is somewhat controversial. Cunningham and colleagues (Cunningham & Sorenson, 2007; Cunningham, 2006; Cunningham & Reidy, 2002) have found that these factors do not predict future dangerousness in prison, and therefore should not be used to determine whether or not the defendant will continue to be a threat to society. Regardless, the defendant’s lack of remorse has been found to be an integral reason jurors’ vote in favor of death (Garvey, 1998), though this could be because it is tied in with jurors’ perceptions of the defendant’s future dangerousness.

Examples: Mitigating Factors

As mentioned earlier, defense attorneys attempt to humanize their client by placing his behavior in a larger context so that jurors can understand the factors that led to the offense (Costanzo, 1997). This will lessen the defendant’s moral culpability and make jurors more likely to vote for a sentence of life imprisonment (Costanzo, 1997). Haney (2005) states that it is the job of defense attorneys to help guide jurors through the “empathic divide,” a “cognitive and emotional distance between [capital jurors and the defendant] that acts as a psychological barrier, making genuine understanding and insight into the role of social history and context in shaping a capital defendant’s life course difficult to acquire” (p. 203).

Several U.S. Supreme Court decisions support the use of mitigating evidence in capital trials. In Lockett v. Ohio (1978), the Court determined that the defense could not be prevented from presenting any evidence in mitigation. In Eddings v. Oklahoma (1982)
the Court expanded this by instructing the jury to consider any mitigating factors including a history of family abuse, lack of maturity, defendant’s youth, and emotional disturbance. The Court then declared in *Penry v. Texas* (2001) that the jury must be given instructions to consider mitigating evidence in determining the defendant’s sentence. And in *Williams v. Taylor* (2000), which was expanded upon in *Wiggins v. Smith* (2003), the Court found that failure on the part of the defense to investigate and present mitigation could result in a violation of effective assistance of counsel. As a result, defense attorneys are required to conduct a thorough investigation of their client’s life history.

Examples of mitigation include mental retardation, emotional distress, abuse and neglect, mental illness, youth at the time of the crime, drug abuse, and domination by others (Costanzo, 1997). Mental illness has been found to be a risk factor for violent behavior, especially in individuals with multiple diagnoses (Fabian, 2009). Individuals with co-occurring diagnoses of substance abuse and antisocial personality disorder (ASPD) and/or psychopathy, in particular, are at significantly greater risk (Monahan et al., 2001). Thus, it is not surprising that some jurors actually find mental illness to be more of an aggravating factor than a mitigating one (Garvey, 1998).

**Child maltreatment.** A history of child abuse or maltreatment is another form of evidence that comes up in mitigation, and numerous studies find a connection between child maltreatment and violent behavior. Being abused or neglected as a child increases the likelihood of arrest as a juvenile and arrest of violent crimes as a juvenile and an adult (Widom & Maxfield, 2001). A child is also more likely to become violent later in life the more violence the child is exposed to at a young age and the more frequent and severe the abuse they experience (Dutton & Hart, 1992). Family violence can put children at risk for
violence through the development of low self-esteem, withdrawal and social isolation, depression, suicide attempts, and delinquency (Widom, 1993). It also puts children at increased risk for developing conduct disorders in childhood and symptoms of ASPD later in life (Rutter, Giller, & Hagell, 1998) and episodes of MD (Major Depression) later in life (Mullen, Martin, Anderson, Romans, & Herbison, 1996).

However, some studies have shown that jurors do not use the history of child abuse in a fully mitigating way. Stevenson, Bottoms, Diamond, Najdowski, Stec, and Pimental (2008) found that an adult defendant described as having a history of child abuse and as having been raised in a turbulent family environment with little parental support resulted in jurors discounting the abuse or even using it against him as an indicator of future dangerousness. Butler and Moran (2002) also found that death-qualified jurors reported on a survey that they would be less likely to use a history of child abuse as mitigating.

More recent research by Stevenson, Bottoms, and Diamond (2010) found that for jurors, child abuse was more likely to function directly as a mitigator than directly as an aggraver, in line with past research by Lynch and Haney (2000) showing that the majority of jurors reported that they considered child abuse as a mitigating factor in a mock jury death penalty case. Additionally, Tetterton & Brodsky (2014) conducted the first study thus far on the cumulative effects of mitigating factors presented to jurors. They found that mock jurors gave more lenient sentences and were less likely to vote for death when the evidence included an increased number of psychosocial and psychological problems. Specifically, they found that the value of the child abuse attributed by jurors was largely dependent on the duration of the abuse and perceived
pervasiveness. Jurors said that they viewed longer periods of abuse as associated with more negative consequences for the defendant, making them less likely to sentence the defendant to death. Interestingly, a ceiling effect occurred after 5 years: after that period, the abuse no longer increased jurors’ compassion or leniency for the defendant (Tetterton & Brodsky, 2014).

Ultimately, the type of information emphasized by the defense and prosecution is dependent on the characteristics of the defendant and the crime.

**Results from the Capital Jury Project**

The Capital Jury Project (CJP) has shed light on various aspects of capital trials, particularly how jurors evaluate various mitigating and aggravating factors. Garvey (1998), in his work on the CJP, asked jurors who had sat on capital cases how they did or would react to various factors in making their sentencing decisions. He found that jurors who had served on death cases were more likely than jurors who had served on life cases to say that a particular aggravating or mitigating factor would make them just as likely to sentence the defendant to death, whereas jurors who had served on life cases were more likely than death-case jurors to say that a particular aggravating or mitigating factor would make them more or less likely to sentence the defendant to death. Garvey (1998) explained that this might be because of one of two things: a) death-case jurors morally justify their decisions to sentence someone to death through the belief that their decision was “unique and perhaps inevitable” (p. 1552), or b) death-case jurors interpret aggravating and mitigating factors differently than life-case jurors.

With regards to mitigation, Garvey’s analysis led him to place mitigating evidence into one of four general categories: residual doubt, proximate culpability,
remote culpability, and relative culpability (Sandys et al., 2010). Garvey argues that the most powerful mitigators fall into the category of residual doubt over the defendant’s guilt, which occurs when jurors have doubt regarding the extent of the defendant’s involvement in the crime. However, few jurors acknowledge the existence of this mitigator (i.e., only 28 jurors in Garvey’s (1998) study).

The next most powerful category is proximate culpability factors, or proximate reduced culpability factors: pieces of evidence that reduce jurors’ perceptions of the defendant’s moral culpability because of factors beyond his control (Sandys et al., 2010). Examples of this include mental retardation, youthfulness, being under the influence of an extreme mental or emotional disturbance, or a history of mental illness. Less powerful mitigators in this category are circumstances that result in a lack of control by the defendant’s own choice (Sandys et al., 2010). For example, Garvey (1998) found that only 18% of jurors viewed the circumstances that the killing occurred while the defendant was either under the influence of drugs or alcohol as mitigating.

The third most powerful group of mitigating factors according to Garvey (1998) are remote culpability factors, “circumstances over which the defendant had no control and that may have helped form (or misform) his character” (p. 1565). Examples of such factors include child abuse and extreme poverty. Although he found that approximately one-third of jurors would assign some weight to child abuse as mitigation, approximately two-thirds assigned it no weight (Garvey, 1998).

The final category of mitigating factors is relative culpability factors, such as when the defendant is convicted with evidence from an accomplice who testified against the defendant in return for a reduced charge or sentence (Sandys et al., 2010). However,
Garvey (1998) found that jurors are not greatly impacted by the presentation of such evidence; a little over two-thirds of jurors said they would be no more or less likely to vote for death.

Overall, Garvey’s (1998) findings suggest that jurors are most greatly impacted by evidence that questions the extent of the defendant’s involvement in the crime as well as factors beyond the defendant’s control. Both mock jury research and the CJP research show that jurors are more receptive to mitigation that explains the defendant’s behavior in the context of physiological and—although slightly less so—psychological factors (Sandys et al., 2010). Finally, a sentence of life in prison is more likely if jurors believe the mitigation presented to them and know how to weigh the importance of such mitigation (Sandys et al., 2010).

**Biological Evidence**

A new form of evidence—biological evidence—has been introduced in the penalty phase of capital trials. The prosecution may use results of a genetic test, for example, to predict the future dangerousness of a defendant if his genetic condition predisposes him to violence. Alternatively, results of a genetic test may be used by the defense to show that the defendant’s genetic makeup reduced his free will or ability to control his behavior and that he is therefore less culpable. Biological evidence is comprised of both genetic evidence and neuroimaging evidence.

**Neuroimaging Evidence in Court**

A predecessor to neuroimaging is X-radiation (X-rays), which was first identified in 1895 (Weiss, 2011) and was introduced in a medical malpractice suit in Colorado only a year later (Golan, 2004). A historical case involving the use of radiographic imagery
was the famous penalty-phase bench trial of Leopold and Loeb in the 1920s (Weiss, 2011). The 18 and 19-year old teenagers had kidnapped, murdered, disfigured, and buried a young boy (Weiss, 2011). Clarence Darrow, the defense attorney, had experts present radiographic evidence of a calcified pineal gland that they claimed contributed to faulty psychological traits in one of the defendants (i.e., Leopold) (Baatz, 2008). When one of the experts, a neuropsychiatrist, was asked if Leopold could have committed the kidnapping and murder had it not been for the presence of the mental disease, he said Leopold “could not have done it” (Baatz, 2008, p. 332-333). Although the prosecution had sought the death penalty, the boys were sentenced to life imprisonment (for the murder) plus an additional 99 years (for the kidnapping) (Weiss, 2011).

The 1930s saw the introduction of the electroencephalogram (EEG), which was initially used more for treatment than jurisprudence (Shorvon, 2009), but by the 1950s made its way into the courtroom as scientific evidence in criminal trials (Conrad, 1959). Computed tomography (CT) imagery was introduced in 1973 (Raichle, 2008) and was admitted as evidence by the court (albeit begrudgingly) just over a decade later in the famous case of John Hinckley to support a diagnosis of schizophrenia (Weiss, 2008).

More modern forms of neuroimaging that have been introduced during the sentencing phase of capital cases include the PET (positron emission tomography) and SPECT (single-photon emission computed tomography) scans (Phillips, 2013) and, more recently, neuroscientists have begun attempting to introduce fMRI (functional magnetic resonance imaging) scans during their testimony in mitigation (Phillips, 2013).

PET, SPECT, and fMRI scans fall under the category of functional neuroimaging techniques, which observe brain function. For example, with an fMRI, as a participant
looks at an image, this results in certain thoughts or feelings, which then activates certain regions of the brain, which are associated with colors on the scan. fMRIs show colorful, three-dimensional images of the brain’s surface. Structural neuroimaging techniques, on the other hand, are used to observe the brain’s structure, e.g., to identify brain tumors, injuries, etc. Examples of structural neuroimaging techniques include the CT and MRI (magnetic resonance imaging) scans. Studies using imaging techniques point to functional and structural impairments in different areas of the brain, which research has found are responsible for predisposing people to commit violent, criminal acts (more on this later) (Phillips, 2013).

The Role and Impact of Neuroimagery in Capital Trials

Neuroscientific evidence has started to find its way into criminal cases to inform a range of issues, including competency to stand trial, mens rea (whether the defendant committed the crime with a guilty mind), insanity (criminal responsibility), and as mitigation in the penalty phase of capital trials (Vincent, 2011; Erickson, 2010; Fabian, 2010). Such evidence can also be used to support a diagnosis that has been made on clinical grounds, such as psychopathy or schizophrenia (Saks, Schweitzer, Aharoni, & Kiehl, 2014).

Surprisingly, courts appear to be more willing to grant attorneys’ motions for neuroimaging tests in death penalty cases than in non-death penalty cases (Edersheim, 2012). However, this may be due to the fact that some defendants have based their death sentence appeals on the claim that they received ineffective assistance of counsel in violation of their Sixth Amendment rights because their attorneys did not present neuroimaging evidence during trial. Furthermore, neuroimagery has been more
successfully introduced in the penalty phase than the guilt phase of capital trials due to the wide range of discretion the defense has in introducing different forms of evidence as mitigation. As mentioned earlier, capital trials have seen the introduction of both structural and functional neuroimages to attempt to show that deficits in the defendant’s brain contributed to his impaired ability to control his violent and impulsive behaviors. Such deficits have included frontal lobe dysfunction, traumatic brain injury, mass lesions, developmental disorders, psychiatric disorders, and substance use disorders (Edersheim, 2012).

The most frequent basis for presenting neuroimaging evidence in mitigation has been in support of the claim that the defendant had visible deficits or abnormalities of his frontal lobes, which hindered him from controlling his aggressive impulses, from making socially appropriate judgments, and from anticipating the consequences of his actions (Seiden, 2004). However, such evidence can be excluded from evidence if its value is outweighed by its undue influence on the jury (US v. Mezvinsky, 2002).

A Notre Dame Law Professor, O. Carter Snead, conducted a survey of cases on appeal that had presented neuroimaging during mitigation in capital trials (Snead, 2007). He discovered that out of 61 cases, 45 cases (73.7%) upheld a sentence of death, 10 cases (16.4%) were remanded for retrial with some reference to neuroimaging, 4 cases (6.5%) were remanded on other grounds, and 2 cases (3.3%) overturned the death sentence for a sentence of life imprisonment (Snead, 2007). In sum, although neuroimaging has been presented as evidence in the penalty phase of capital trials, a sentence of death has resulted in the majority of cases (Edersheim, 2012). But for trials that have resulted in life
imprisonment, during post-sentencing interviews, jurors have claimed that neuroimages played a significant role in their decision (Kulynych, 1997).

**Genetic Links with Criminality**

Beyond the association between brain abnormalities or deficits and criminal behavior, scientists believe there is a genetic component to criminality due to research finding higher rates of criminal behavior among the offspring of criminals (Bernet, Vnencak-Jones, Farahany, & Montgomery, 2007), and research on psychopathy indicating a genetic component to criminality (Phillips, 2013). Although approximately only 1-5% of the population suffers from psychopathy, 15-30% of the prison population is comprised of individuals who could be labeled psychopaths, and psychopaths commit 50% more crimes than non-psychopathic criminals (Viding, 2004).

In the late 1960s, it was thought that males with an XYY chromosome were more predisposed to violent, criminal behavior (Ellis, 1982). This information was used as a criminal defense in a handful of trials (Denno, 1996), but a lack of sufficient evidence linking the gene to violent behavior made its time in the courtroom short-lived (Hoffman & Rothenberg, 2007). During the guilt phase of a capital trial, genetic evidence has been used to support a defense of insanity or diminished capacity, such as when the defendant has Down Syndrome or Huntington’s Disease (Bernet & Alkhatib, 2009).

**The MAOA gene.** Brunner, Nelen, Breakefield, Ropers, and van Oost (1993) were the first to identify a single gene that is linked to violence and aggression: the *MAOA* gene. Further research revealed that the *MAOA* gene has several variations. The number of nucleotide tandem repeats (VNTR) vary from 1 to 5, with three or four repeats
being the most common (30% of the alleles in the general population contain three repeats and 65% of the alleles contain four repeats) (Kim-Cohen et al., 2006).

The MAOA gene, or so-called “warrior gene” (Shniderman, 2014, p. 2), encodes the MAOA enzyme, which metabolizes neurotransmitters such as serotonin, dopamine, and norepinephrine (Bernet & Alkhatib, 2009). Alleles (one of two or more possible versions of a particular gene) with three repeats are associated with low activity of the MAOA enzyme and alleles with four repeats are associated with high activity of the MAOA enzyme (Baum, 2013). Because the MAOA gene is located on the X chromosome, males can only have one allele, and those with the low-activity allele will not be able to metabolize serotonin, dopamine, and norepinephrine efficiently (Bernet & Alkhatib, 2009). Thus, men are more at risk than females for inheriting the non-functional copy of the MAOA gene.

Individuals with the low-activity MAOA gene may perform poorly on tests of executive functioning (e.g., working memory or attentional control) because their frontal lobes are less involved in such processes, indicating a possible difficulty in controlling aggressive and antisocial impulses (Byrd & Manuck, 2013; Enge et al., 2011; Cerasa et al., 2008). Research on the low-activity MAOA gene has observed that it is associated with heightened sensitivity to stress (Manuck & McCaffery, 2014), heightened attention to negative emotional stimuli (Pergamin-Hight, Bakermans-Kranenburg, van IJzendoorn, & Bar-Haim, 2012), heightened cortisol reactivity to acute psychological stressors (Miller, Wankerl, Stalder, Kirschbaum, & Alexander, 2013), and enhanced reactivity to threat-related stimuli in the amygdala and altered neural coupling with prefrontal
regulatory regions (Drabant et al., 2012; Hariri et al., 2005; Munafo, Brown, & Hariri, 2008).

Furthermore, Sjoberg et al. (2008) found that high levels of testosterone, which has been shown to correlate with ASPD, correlated with ASPD and aggression only in males with the low-activity MAOA gene. Importantly, there was no significant correlation between males with the high-activity MAOA gene producing testosterone and ASPD or aggression (Sjoberg et al., 2008). Buckholtz et al. (2008) went on to show that males with the MAOA polymorphism (i.e., low-activity allele) had increased processing between the ventromedial prefrontal cortex (vmPFC), known to be associated with impulse repression, and the amygdala, known to be associated with emotional salience. Observations from these studies support the hypothesis that the MAOA polymorphism is genetic evidence of why people may react differently to life adversities (Manuck & McCaffery, 2014).

**MAOA Evidence in Criminal Trials**

Thus far, the MAOA gene has come up as evidence in very few criminal trials. However, new advances in behavioral science may result in such evidence having greater impact in the future. One reported case occurred in 2009, when an Italian appeals court allowed an expert to present genetic evidence, claiming that the defendant was a schizophrenic who carried the low-activity MAOA gene, which made him vulnerable to becoming aggressive in stressful situations (*Buyout v. Francesco*, 2009). His sentence was reduced from 9 years to 8.
Issues Related to the use of Biological Evidence in the Courtroom

A concern with allowing genetic tests as evidence in the courtroom is that jurors and judges may give such information undue weight because they appear conclusive, when in fact they may only be somewhat predictive of a genetic condition (Hoffman & Rothenberg, 2007). Similarly, a concern with allowing neurological evidence in the courtroom is that this evidence will be more persuasive than testimony by lay, psychological, or psychiatric experts because it allows jurors to “see” the source of the aberrant behavior (Brown & Murphy, 2010; Batts, 2009; Gurley & Marcus, 2008). I discuss the impact of this evidence on legal decision-makers later in the proposal.

Others argue that neuroimagery does not necessarily describe how a certain area of the brain may be functioning, and that a neuroimage alone may only connect an abnormality shown in a scan to an abnormal set of behaviors through one’s own inferences (Tancredi & Brodie, 2007). Furthermore, Schweitzer & Saks (2011) explain that brain function changes over the course of time, so a test taken during the course of a trial may not be indicative of the defendant’s brain function at the time of the offense.

Another issue with presenting such evidence is that it might not be interpreted by the jury as it is intended to be. That is, the defense may produce a neuroimage or genetic test as mitigation, but it may instead be viewed as an aggravator. Jurors may see the defendant as permanently damaged and unfixable, leading them to punish the defendant even more harshly to prevent any future harm he might cause (Phillips, 2013). Batts (2009) stresses that if neuroimaging is to be introduced as evidence in legal proceedings, it is important that it occurs in a way that is “scientific, logical, and free of bias” (p. 270), otherwise defense attorneys may attempt to argue that certain crimes are the result of
neurological defects, and jurors may be overwhelmed by the presentation of such information.

**Benefits Related to the Use of Biological Evidence in the Courtroom**

If people can accept that the brain causes mental states, and that mental states are relevant to determinations of criminal responsibility and punishment, then an increased understanding of the biological nature of mental states would provide insight into the defendant’s ability to have knowingly and intentionally committed a crime (Batts, 2009). Therefore, evidence supporting a mental defect in the defendant can help explain why he had an increased likelihood of committing the crime and why he may have less control over his behavior and moral judgment.

Neuroscientific evidence can also aid defense attorneys representing psychopathic individuals facing the death penalty (Phillips, 2013). Due to the fact that psychopaths have few likeable personality traits, are thought to be disturbed and dangerous individuals, and often lack the types of close relationships that could assist them by producing mitigating testimony, defense attorneys’ jobs are even more difficult when their client is a psychopath. Therefore, neuroscientific evidence can support their clients’ psychopathy with information jurors can visually pinpoint.

**Genetic X Environmental Interactions on Criminality**

The infamous nature/nurture debate of the early- and mid-twentieth century gave rise to genetic-environmental (G X E) interactions (Cravens, 1988). Studies of G X E interactions first began with the diathesis-stress model of disease risk from the 1960s, which hypothesizes that when people with genetic vulnerabilities to disease are confronted with stressful life events, they are more likely to develop a mental disorder
Researchers have also begun to use G X E interactions to understand how people are affected by adversities as children. Specifically, the MAOA gene has been examined as a potential moderator of the relationship between child maltreatment and subsequent outcomes (Nikulina, Widom, & Brzustowicz, 2012). One of the earliest studies examining this relationship was conducted by Caspi et al. (2002), who discovered that males with the low-activity MAOA gene who had also experienced child maltreatment were more likely to have committed violent crimes later in life, and that the high-activity gene was found to be protective against the harmful effects of child maltreatment. These findings have been fully replicated (Foley et al., 2004; Nilsson et al., 2006; Kim-Cohen et al., 2006), partially replicated (Widom & Brzustowicz, 2006; Weder et al., 2009; Prom-Wormley et al., 2009), and have failed to be replicated (Huizinga et al., 2005; van der Vegt et al., 2009). A meta-analysis conducted by Taylor and Kim-Cohen (2007) found a significant effect of MAOA as a moderator of the relationship between child maltreatment and antisocial behavior.

Although there are discrepancies in the results of the studies attempting to replicate Caspi et al.’s (2002) study, it is important to note that those studies differed with regards to the operationalization of child maltreatment, the study design (i.e., cross-sectional vs. longitudinal), sex, race/ethnicity, and the outcome assessed (Nikulina et al., 2012). It is therefore important that child maltreatment be better defined in the future, for it may one of the leading reasons for differing results (Tremblay & Szyf, 2010).

Research has also looked at MAOA predicting symptoms of Antisocial Personality Disorder (ASPD). For example, Brunner, Nelen, Breakefield, Ropers, and van Oost
(1993) found that a rare mutation of the gene is associated with aggressive behaviors. Additionally, Kendler and Prescott (2006) and others at the Virginia Adult Twin Study of Psychiatric and Substance Use Disorders conducted twin studies for over two decades and discovered that both genetic and environmental factors are related to conduct disorder and antisocial behavior in adults, demonstrating a G X E interaction.

In sum, MAOA has been found to interact with child maltreatment in predicting violent crime and aggression. Although G X E interactions have been criticized for their limited success with regards to replication and their vulnerability to publication bias (Manuck & McCaffery, 2014), Baum (2013) notes that this relationship has “advanced farther than any of its contemporaries or predecessors in the association with impulsive violence” (p. 304).

**MAOA x Child Maltreatment Evidence in Criminal Trials**

The 2009 case of Davis Bradley Waldroup was one of the first in which evidence of a G X E interaction (specifically, the low-activity MAOA gene and childhood abuse) was admitted in the guilt phase of a capital trial. The prosecutor subsequently dropped the charges from 1st degree murder to voluntary manslaughter; Waldroup was also convicted of especially aggravated kidnapping and attempted 1st degree murder (*Polk News*, 2009).

In an earlier case, *Mobley v. State* (1995), the defense requested MAOA genotyping for the defendant, Stephen Mobley, a 29-year old man accused of murder. Unfortunately for Mobley, the MAOA x environment interaction had not yet surfaced, and the judge determined the lack of scientific verifiability made the request unwarranted. Mobley received the death sentence and was later executed.
Impact of Biological Evidence on Legal Decision-Makers

The Impact of Neuroimaging Evidence

Although not specifically examining the use of neuroimagery in criminal trials, there is evidence to suggest that neuroimagery can in fact enhance the persuasiveness of the arguments it accompanies and cloud jurors’ judgments of expert evidence. Weisberg, Keil, Goodstein, Rawson, and Gray (2008) found that in the absence of neuroscience, participants were able to distinguish between good and bad explanations for psychological phenomena. However, the presence of (irrelevant) neuroscience information made naïve adults and neuroscience students more likely to find the poor explanations satisfying. It was only the experts who were able to see the neuroscience information as irrelevant (Weisberg et al., 2008).

Along a similar vein, McCabe and Castel (2008) conducted three experiments and found that newspaper-type articles on psychological research findings that were accompanied by an image of a brain were more persuasive than articles accompanied by a bar graph or topographical map of brain activity. This effect occurred even when the article questioned neuroimages’ ability to address the findings in a valid way. These observations show the power neuroimages have in validating research findings to jurors asked to evaluate research (McCabe & Castel, 2008).

However, research by Schweitzer and colleagues (Schweitzer, Saks, Murphy, Roskies, Sinnott-Armstrong, & Gaudet, 2011; Schweitzer & Saks, 2011) has demonstrated that presenting neuroimaging evidence to jurors will not unfairly influence them. Schweitzer et al. (2011) had participants read testimony from a neurologist describing a neurological defect in the defendant in a mens rea defense case and found
that also showing a neuroimage to jurors did not influence their verdict, sentencing
decisions, or other judgments of the case over and above the expert’s verbal testimony.
Similarly, Schweitzer & Saks (2011) found that simply displaying a neuroimage to jurors
did not increase their willingness to find a defendant not guilty by reason of insanity
(NGRI).

A number of studies have also examined the impact of neuroimaging evidence on
mock jurors’ sentencing of capital defendants. As one example, Greene and Cahill (2012)
presented to mock jurors neuroimages and neuropsychological test results as diagnostic
evidence of a psychosis in a defendant and manipulated the future dangerousness of the
defendant (either high or low). They found that neuroimages and neuropsychological
tests reduced the likelihood of sentencing the defendant to death compared to the
diagnosis-only condition, but only for defendants described as having a high risk of
future dangerousness. However, neuroimaging evidence and neuropsychological
testimony did not reduce recommendations for death above and beyond
neuropsychological testimony alone. When the defendant was described as having a low
risk of future dangerousness, Greene and Cahill (2012) explain that neuropsychological
tests and neuroimagery might not have been as effective because a diagnosis of psychosis
and a lack of future dangerousness were already mitigating.

Interestingly, Greene and Cahill (2012) also found that neuropsychological tests
and neuroimages had mitigating effects on jurors’ impressions of the defendant in both
dangerousness conditions: the defendant was seen as more sympathetic and remorseful,
less capable of controlling his behavior, and less responsible for his actions when
biological evidence was presented. The only difference between the low and high risk of
dangerousness conditions was that those in the low-risk condition rated the phrase “he can be rehabilitated in prison” as more descriptive of the defendant than those in the high-risk condition (Greene & Cahill, 2012).

Recent research by Saks et al. (2014) examined the impact of neuroimages in the penalty phase of a capital murder trial by conducting two separate experiments. Both experiments compared the impact of neuroimages with other forms of evidence, specifically neuroscience expert testimony, evidence of a genetic abnormality, and clinical psychological examination, all of which led to the same diagnosis. Another independent variable was the diagnosis itself: either psychopathy or schizophrenia. The first experiment included conditions in which the defendant was described as healthy, and the second experiment manipulated which side offered the neuroscience expert evidence (i.e., either the prosecution or defense) (Saks et al., 2014).

In the first experiment, defendants diagnosed with psychopathy were more likely to have their lives spared when they presented expert testimony accompanied by neuroimagery (Saks et al., 2014). In the second experiment, neuroimages presented by the defense during mitigation also reduced sentences of death. However, when neuroimaging evidence was presented with additional evidence such as neurological testimony, genetics, or clinical testimony, the rate of death sentences was even greater. Similarly, when the prosecution presented neuroimagery, it resulted in more death sentences, and when further forms of evidence accompanied it, it decreased death sentences. Overall, Saks et al. (2014) concluded that although neuroimagery aided whichever side presented it as evidence, the effect was not large enough to support the
concern that such evidence would be disproportionately prejudicial, and that so long such evidence is found to be admissible in court, there is no reason to exclude it.

In sum, it appears that neuroimaging evidence can bolster the argument of whichever side is introducing it, though it is not unduly biasing.

**The Impact of MAOA on Legal Decision-Makers**

In a nationwide experiment conducted by Aspinall, Brown, and Tabery (2012), trial judges read a case summary (based on an actual case) of a restaurant robbery which resulted in the defendant causing the manager of the restaurant permanent brain damage after delivering several blows to the head. A jury found the defendant guilty of aggravated battery. Participants were randomly assigned to a condition where a biomechanism either was or was not accompanied by psychiatric expert testimony of the defendant’s psychopathy, which was presented either by the prosecution or the defense. Thus, it was a 2 X 2 between-subjects factorial design (Aspinwall et al., 2012).

Specifically, participants in the biomechanism-present condition were given additional expert testimony from a neurobiologist regarding how the defendant was a carrier of the low-activity MAOA gene, which contributed to the development of his psychopathy (Aspinwall et al., 2012). When the prosecution presented this information, they argued that it was aggravating because it showed the defendant posed a continued threat to society; when the defense presented this information, they argued that it was mitigating because it showed the defendant had difficulty controlling his impulses (Aspinwall et al., 2012).

After being presented with this information, judges were then asked the degree to which the evidence associated with psychopathy played a mitigating, aggravating, or no
role in their sentencing decision (Aspinwall et al., 2012). They were also asked to rate the
defendant’s legal responsibility, moral responsibility, free will, to estimate their personal
average sentence for aggravated battery, and to provide their own sentence for the
defendant (in years) (Aspinwall et al., 2012).

Results showed that presenting evidence of a biomechanism at sentencing to
explain the defendant’s psychopathy significantly reduced judges’ ratings of psychopathy
as aggravating and significantly reduced the length of their sentencing decisions
(Aspinwall et al., 2012). The presentation of the biomechanism by the defense also
increased the number of judges’ listing a mitigating factor, particularly that the defendant
was mentally ill and lacked control over his actions. (Judges were asked this information
to determine the reasons behind their sentencing decisions, which is not often publicized.)
In conclusion, Aspinwall et al. (2012) found that evidence of a biomechanism can
function to mitigate judges’ sentencing decisions by pointing to the defendant’s lack of
control, thereby rendering him less culpable.

The study by Aspinwall et al. (2012) examined the impact of evidence supporting
a biological cause of the defendant’s behavior on the judgments of judges only.
Therefore, the next logical step is to assess the impact of evidence of a biomechanism
(i.e., the low-activity MAOA gene) on jurors. Based on research supporting a link
between the low-activity MAOA gene and child maltreatment on violent, criminal
behavior, this study takes a step even further by adding in the environmental component
to see the effects of this specific G X E interaction on jurors’ sentencing decisions in a
simulated capital trial. Prior to getting into the details of the study itself, I mention some
important comments/findings regarding the impact of deliberation on jurors.
Impact of Deliberation on Jurors’ Verdicts

Most jurors do not begin the process of deliberation already in agreement of what the verdict or sentence (in capital trials) should be. Rather, consensus is achieved through the deliberation process itself, where some jurors change their minds through the process of social influence (Devine, 2012). Majority factions exert a larger amount of influence in a jury than minority factions can due to the number and quality of the arguments they present. Accordingly, research has found a strong relationship between the verdict preference of the majority at the start of deliberation and the jury’s ultimate verdict. For example, MacCoun and Kerr (1988) conducted a meta-analysis of several criminal mock jury studies and found that the probability of a given faction predominating (with regards to the verdict) increases with each additional member and becomes particularly high at a two-thirds majority. Furthermore, the majority effect has been found to hold in studies where jurors must decide whether the defendant will receive death or life imprisonment. Eisenberg, Garvey, and Wells (2001) observed that in 21 cases where 66% or less of the jury supported a sentence of death on the first vote, the jury always sentenced the defendant to life imprisonment, whereas when 76% or more of the jury favored a sentence of death, the jury always sentenced the defendant to the death.

Interestingly, research also suggests that the deliberation process itself induces greater leniency in criminal jurors under certain conditions, known as a leniency bias (MacCoun & Kerr, 1988). This has been found even when there is no clear pre-deliberation juror verdict preference (Eraser, Thompson, & Gutowski, 1986; MacCoun, 1984; Kerr, 1982) and even when jurors appear to initially somewhat favor conviction (Tanford & Penrod, 1986). Also known as the asymmetry effect, it suggests that a pro-
acquittal faction is more influential than a pro-conviction faction of similar size (MacCoun & Kerr, 1988). The same meta-analysis conducted by MacCoun and Kerr (1988) found that juries that were even split at the start of deliberation were four times more likely to acquit than convict. They also found this asymmetry effect in a mock jury study using both student and community samples (MaCCoun & Kerr, 1988). Devine, Clayton, Dunford, Seying, and Price (2001) observed similar results in their own meta-analysis, which used over twice as many studies. Specifically, they found “win” rates of 70% for two-thirds majorities favoring conviction and 96% for two-thirds majorities favoring acquittal, with evenly split jurors convicting only 22% of the time.

MacCoun and Kerr (1988) also varied the operative standard of proof and found that there was a significant leniency asymmetry in the reasonable doubt standard which did not hold for the preponderance of evidence standard. They posited that one reason for this could be that it is “easier to raise a single reasonable doubt standard than to refute all possible reasonable doubts” (Kerr & MacCoun, 2012, p. 599). Finally, they examined the correlation between the initial pre-deliberation conviction rate of the entire sample and the asymmetry effect and found that they were negatively related (MacCoun & Kerr, 1988). Additionally, the one case with a non-lenient asymmetry affect had the strongest prosecution evidence. Overall, this suggests that the asymmetry effect is contingent both on the values portrayed by the judge’s instructions and the strength of the evidence against the defendant (MacCoun & Kerr, 1988, 2012).

In conclusion, a juror leniency effect is more likely to emerge in jury deliberations where cases are close (i.e., where the prosecution and defense have equally strong cases). Simulation studies tend to be relatively close (by design), hence the benefit of choosing
to do a simulation of a jury deliberation. Furthermore, one would expect to see a greater leniency bias in jury deliberations than in juror deliberations; initial doubts in sentencing the defendant to death will inevitably be more likely to spread in a jury deliberation than in a single juror deliberation (where, if no such doubt initially exists, one would think is unlikely to develop at all).

The Present Study

The present study tests the effects of environmental, genetic, and G X E explanations of the defendant’s behavior on jurors’ sentencing decisions in a death penalty case. Therefore, it looks only at how this information affects jurors when it is presented by the defense. It also examines whether these effects differ as a function of the defendant’s future dangerousness, as testified to by a prosecution expert witness. After reading a case summary, participants completed individual pre- and post-deliberation questionnaires in addition to deliberating as a group to reach a unanimous sentencing decision. To assess the impact of the evidence on their sentencing decisions as individuals, I examined their pre- and post-deliberation judgments. To assess the impact of the evidence on their sentencing decisions as a group, I examined jury verdicts.

Design

The study utilizes a 2 X 4 between-subjects factorial design (see Table 1 for sample distribution across conditions). I manipulated evidence of future dangerousness presented by the prosecution (Low or High) and the explanation of the defendant’s behavior by the defense (Control, Environmental, Genetic, or G X E).
**Hypotheses**

I predicted that there would be a main effect of future dangerousness on verdicts, with the High Dangerousness conditions resulting in more death sentences than the Low Dangerousness conditions. I also predicted a main effect of the explanation of the defendant’s behavior on verdicts, with the G X E condition resulting in fewer death sentences than the Control, Environmental, or Genetic conditions. It was therefore predicted that the G X E – Low Dangerousness condition would result in the fewest death sentences overall. I expected that these effects would be shown in both juror and jury verdicts, though because of the jury leniency effect, might be stronger in the latter.

**Table 1**

*Distribution of Participants Across Conditions*

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Environmental</th>
<th>Genetic</th>
<th>G X E</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Dangerousness</td>
<td>77</td>
<td>69</td>
<td>77</td>
<td>67</td>
<td>290</td>
</tr>
<tr>
<td>High Dangerousness</td>
<td>81</td>
<td>76</td>
<td>79</td>
<td>74</td>
<td>310</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>145</td>
<td>156</td>
<td>141</td>
<td>600</td>
</tr>
</tbody>
</table>
CHAPTER III

METHOD

Participants

Participants (N = 600) were a combination of students (n = 302) and community members (n = 298). Students were recruited from undergraduate psychology classes at the University of Colorado at Colorado Springs and community members were recruited from Amazon’s Mechanical Turk. Students were compensated with 3 points of course credit and community members received $0.44.

All participants were death-qualified and jury-eligible (i.e., at least 18 years old and had a valid driver’s license or were registered to vote). Participants were between the ages of 18 and 65 years old (M = 28.24, SD = 10.50). Most participants were female (63.4%), Caucasian (66.3%), and moderate in their political beliefs (46.5%). 40.8% of participants knew someone who had been the victim of a violent crime and 20.0% of participants had been the victim of a violent crime. Only 6.5% of participants had specialized knowledge of genetics and only 6.3% had served on a jury in a criminal case.

1Using G*Power 3 (Faul, Erdfelder, Lang, & Buchner, 2007), I conducted an a priori power analysis to determine the sample size necessary to conduct an ANOVA. I used an anticipated partial η^2 of .036 (small effect size), which I obtained from the Greene and Cahill (2012) study by calculating the average effect sizes of impressions of the defendant (who used a similar study design—a 2 X 3 between-subjects factorial—and similar variables—future dangerousness evidence presented by the prosecution and evidence presented by the defense). Also using an alpha of .05 and a power level of .08, I found that I would need approximately 296 participants for this study. Since a grant was obtained to recruit a community sample, I matched sample sizes between the student and community samples using this power analysis.
Materials

**Death qualification questionnaire.** Potential participants were first required to answer one question online to determine if they were death-qualified and thus, eligible to decide a death penalty case. This is the same question that was used in the Greene and Cahill (2012) study. Participants were asked to indicate which of the following statements best captures their personal beliefs about capital punishment: *(a) If a defendant was found guilty of a murder for which the law allowed a death sentence, I would sentence the defendant to death even if the facts in the case did not show that the defendant deserved a death sentence; (b) I am in favor of the death penalty, but I would not necessarily vote for it in every case where the law allowed it. I would consider the facts of the particular case that pertain to the death penalty and then decide whether to sentence the defendant to death; (c) Although I have doubts about the death penalty, I would be able to find a defendant guilty and vote for a death sentence where the law allowed it, if the facts of the case showed that the defendant was guilty and should be given a death sentence; (d) I have such strong doubts about the death penalty that I would be unable to find a defendant guilty and vote for a death sentence where the law allowed it, even if the facts of the case showed that the defendant was guilty and deserved a death sentence.* Individuals responding either (a) or (d) were eliminated from participation in the study (n = 115). Participants were relatively evenly split between options (b) and (c): 52.5% of participants responded (b) and 47.5% responded (c).

**Trial summary.** Participants read a case summary of an actual death penalty case involving the murder of a prison inmate, Anthony Brown, by fellow inmate, John Awai (the names of victim and defendant have been changed but the details are factual). They were informed that a separate jury convicted the defendant, John Awai, of first-degree murder, and
that it is their task to determine if he should receive the death penalty or life imprisonment without the possibility of parole. The trial summary consisted of the following components:

**Judge’s instructions.** Participants read judge’s instructions after reading the case summary and again after reading the expert testimony. The first, preliminary set of judge’s instructions defined mitigating and aggravating circumstances and instructed jurors on how to weigh such evidence in determining whether the defendant should be sentenced to death or life imprisonment. The second, final set of instructions informed jurors that it is time for them to make their sentencing decision, and that this decision is one they must make as a group. The first set of instructions was approximately 400 words long and the second set of instructions was approximately 150 words long.

**Defendant’s background information.** Participants read background information regarding the defendant, John Awai, as would typically be presented as mitigation in a death penalty case. This included childhood history, family history, education, work history, marital history, and mental health history. The information varied slightly depending on the condition a participant was placed in. Specifically, the Environmental and G X E conditions included information in the section on childhood history of the defendant’s history of child abuse. Altogether, the background information was approximately 500 words long.

**Expert testimony.** The prosecution called one expert, a clinical forensic psychologist, to testify on the likelihood that the defendant will represent a continued danger to society. In the Low Dangerousness condition, the psychologist testified that after reviewing an extensive amount of information, including an interview from the defendant and others who know him, she concluded that he is at “low risk” of being dangerous in the
future, whereas in the High Dangerousness condition she testified that she concluded he is at “high risk.”

The defense called two experts, first a psychiatrist, who testified to the defendant’s social and psychological history, and second a medical geneticist, who testified to the defendant’s genetics and, for the G X E conditions, interaction of genetics and environmental influences. Participants read one of eight versions of the expert testimony presented by the defense. All three experts underwent brief cross-examination. A brief explanation of how the expert testimony in the various conditions differs is given below.

In the Low Dangerousness conditions, the prosecution psychologist testified that in forming her opinion on the defendant’s likelihood of representing a continued threat to society, she relied on “aggregate or group data showing that the rate of serious prison violence among murderers ranges from only 10-20% across lifetime confinement,” and that such a probability of violence could be reduced by “more secure confinement.” In the High Dangerousness conditions, she testified that she relied on “aggregate or group data showing that the rate of serious prison violence among murderers who suffer from depression and anxiety over many years (as Awai has done), who are heavy drinkers, and who lack a stable work environment range from 70-80%,” concluding that there is a high probability the defendant “will commit further acts of violence while incarcerated.”

The Environmental and G X E conditions included testimony from one of the defense psychologist’s, the psychiatrist, regarding the defendant’s history of child abuse and the association between child abuse and behavioral and mental health problems, including “antisocial behavioral problems,” “anger management problems,” and “chaotic family environment.” He concluded that the defendant’s “maltreatment as a child made it impossible
for him to conform his behavior to society's requirements.” This expert also testified across all conditions that the defendant “does not have a diagnosable mental illness.”

The other defense expert, the medical geneticist, testified that the defendant underwent various genetic tests to determine whether there may be a genetic explanation for his impulsivity. In the Environmental conditions, she testified that the defendant does not carry the mutation of the \textit{MAOA} gene. The Genetic conditions included testimony from the geneticist stating that the defendant does carry the low-activity \textit{MAOA} gene. She proceeded to explain what this gene is responsible for and how the low-activity gene has been found to be associated with “poor impulse inhibition” and “vulnerability toward violent, antisocial behavior.” In the G X E conditions, she testified (in addition to what was included in the Genetics conditions) to how the defendant’s history of child abuse and genetics (i.e., low-activity \textit{MAOA} gene) interact, and how these “factors outside of his control” could explain his violent and impulsive behavior. The Control conditions did not include testimony from the medical geneticist. The expert testimony was approximately 1200 words long.

**Individual pre-deliberation questionnaire.** Participants completed the pre-deliberation questionnaire after reading the case summary but prior to deliberation (for the student sample only). This included questions about the evidence, questions about the defendant, and questions about the expert testimony. There were four versions of this questionnaire (for the Control, Environmental, Genetics, and G X E conditions).

The first question on the pre-deliberation questionnaire asked participants to give their individual verdict of either death or life imprisonment. They were then asked on a six-point Likert-type scale ranging from \textit{not at all appropriate} to \textit{extremely appropriate}: “Given the evidence that you have seen in this case, how appropriate is a death sentence for the
defendant?” They were also asked to give a percentage from 1 to 100 for each source of information but totaling 100, “How much does each of the following sources of information contribute to your decision about the appropriateness of the death penalty?” Each condition included “details about the present offense” and “the defendant’s future dangerousness,” but the Genetics conditions also included “impact of the low-activity MAOA allele on the defendant’s behavior,” the Environmental conditions also included “impact of childhood maltreatment on the defendant’s behavior,” and the G X E conditions included “impact of the combination of the low-activity MAOA allele and childhood maltreatment on the defendant’s behavior.”

Participants were asked on a five-point Likert-type scale ranging from not at all to extremely well how well the following words describe the defendant: (a) he is dangerous to other people, (b) he can be rehabilitated in prison, (c) he is unable to control his behavior, (d) he is responsible for his actions, and (e) his behavior was unreasonable under the circumstances. Participants were then asked to answer on a six-point Likert-type scale ranging from strongly disagree to strongly agree a set of questions regarding the prosecution’s expert psychologist. Specifically, it read: the prosecution’s expert testimony regarding the defendant’s risk of future dangerousness (a) helped me understand the defendant, (b) was complicated and difficult to understand, and (c) strongly influenced my decision about the death penalty. Using this same scale, participants were then asked to answer these same three questions regarding both defense experts with the addition of one more question. It read: the defense’s expert testimony regarding the defendant’s social and psychological history/genetics (d) was a blatant attempt to provide an excuse for the defendant’s behavior. They were also asked, using the same scale as the previous set of
questions about the experts, how well “psychologists can accurately explain how someone’s early childhood experiences may influence their behavior later in life,” and how well “geneticists can accurately explain how someone’s genetics may influence their behavior later in life.”

Finally, they were asked some demographic questions, including gender, age, ethnicity, political orientation, whether or not he or she has been the victim of a violent crime (physical or sexual abuse, assault, etc.), has known someone close to him or her who was the victim of a violence crime, has specialized knowledge about genetics, and has ever served on a jury in a criminal case.

**Jury verdict form.** The student sample deliberated as a group to attempt to come to a unanimous decision to either sentence the defendant to death or life imprisonment without the possibility of parole. One member of the jury completed a verdict form.

**Individual post-deliberation questionnaire.** There were four versions of the post-deliberation questionnaire (for the Control, Environmental, Genetics, and G X E conditions). This questionnaire asked participants (students only) to decide what their individual verdict is (either death or life imprisonment), after having deliberated. The second question asked them on a six-point Likert-type scale ranging from *strongly disagree* to *strongly agree*: “Assuming your jury reached a unanimous verdict, how strongly do you agree with the group verdict?” The third question asked them how appropriate they believe a death sentence is after having deliberated using a six-point Likert-type scale ranging from *not at all appropriate* to *extremely appropriate*. Finally, they were asked the same questions they were asked in the pre-deliberation questionnaire (which differed slightly based on the condition they were placed in): giving a percentage from 1 to 100 for each source of information but totaling 100,
“How much does each of the following sources of information contribute to your decision about the appropriateness of the death penalty?”

**Procedure**

Students registered for the study on the University’s online SONA system and answered questions to determine if they were death-qualified and jury eligible. Those who met participation requirements were able to pick a time to come in to the lab which was configured like a jury deliberation room. Community members completed questions regarding death qualification and jury eligibility online using Amazon’s Mechanical Turk. Those who met these requirements were able to complete the study online.

At the beginning of the study, all participants (students and community members) first read a brief introduction to the study, the case summary, and the judge’s instructions. Next, participants completed the individual pre-deliberation questionnaire. The student sample then deliberated as a group for approximately 45 minutes and determined if the defendant should receive a sentence of death or life imprisonment without the possibility of parole. If they were unable to reach a unanimous decision after their 45 minutes were up, they received an additional 25 minutes. Each jury consisted of five to eight participants, all of whom read the same evidence (i.e., they were all in the same condition of the 2 X 4 design). Students then completed the individual post-deliberation questionnaire. Finally, all participants completed the demographic questionnaire. It took mock jurors on average 25.73 minutes to deliberate ($SD = 20.57$).
CHAPTER IV
RESULTS

Descriptive Statistics

**Questions about the evidence.** On average, participants felt the death penalty was moderately appropriate for the defendant described in the case ($M = 2.89$, $SD = 1.39$). Participants presented with the evidence of child maltreatment felt it made them somewhat less likely to sentence the defendant to death ($M = 1.82$, $SD = .62$). Participants presented with the genetic evidence felt it made them somewhat less likely to sentence the defendant to death ($M = 2.25$, $SD = .76$). Participants presented with both the environmental and genetic evidence felt it made them somewhat less likely to sentence the defendant to death ($M = 1.91$, $SD = .69$). And participants presented with the low risk of future dangerousness evidence felt the defendant’s risk of future dangerousness made them somewhat less likely to sentence the defendant to death ($M = 2.25$, $SD = .89$), whereas participants presented with the high risk of future dangerousness evidence felt the defendant’s risk of future dangerousness made them somewhat more likely to sentence the defendant to death ($M = 2.93$, $SD = .80$).

Before deliberation, participants felt their decision to sentence the defendant to death was based primarily on the details of the present offense (49.64%) and defendant’s risk of future dangerousness (32.50%). Participants felt the combination of environmental and genetic evidence made the next largest contribution (28.60%), followed by the environmental
evidence alone (26.60%), and finally the genetic evidence alone (18.57%). This pattern was fairly consistent after deliberation: 48.79% details about the present offense, 32.74% defendant’s risk of future dangerousness, 28.88% combination of environmental and genetic evidence, 29.50% environmental evidence alone, and 17.76% genetic evidence alone.

Questions about the defendant. On average, participants felt the phrase “John Awai is dangerous to other people,” described the defendant fairly well ($M = 3.46$, $SD = 1.01$). They felt the phrase “John Awai can be rehabilitated in prison” described the defendant fairly well ($M = 2.62$, $SD = 1.07$). They felt the phrase “John Awai is unable to control his behavior” described the defendant fairly well ($M = 2.98$, $SD = 1.01$). They felt the phrase “John Awai is responsible for his actions” described the defendant very well ($M = 3.96$, $SD = .98$). And they felt the phrase “John Awai’s behavior was reasonable under the circumstances” did not describe the defendant well ($M = 2.25$, $SD = 1.07$).

Questions about the expert testimony. Participants slightly agreed with the statement “the prosecution’s expert testimony helped me understand the defendant” ($M = 4.02$, $SD = 1.21$); moderately disagreed with the statement “the prosecution’s expert testimony was complicated and difficult to understand” ($M = 2.42$, $SD = 1.27$); and slightly disagreed with the statement “the prosecution’s expert testimony strongly influenced by decision about the death penalty” ($M = 3.46$, $SD = 1.36$).

Participants slightly agreed with the statement “the defense’s expert testimony regarding the defendant’s social and psychological history helped me understand the defendant” ($M = 4.25$, $SD = 1.13$); slightly disagreed with the statement “the defense’s expert testimony regarding the defendant’s social and psychological history was a blatant attempt to provide an excuse for the defendant’s behavior” ($M = 2.70$, $SD = 1.37$); moderately disagreed
with the statement “the defense’s expert testimony regarding the defendant’s social and psychological history was complicated and difficult to understand” ($M = 2.16$, $SD = 1.17$); and slightly disagreed with the statement “the defense’s expert testimony regarding the defendant’s social and psychological history strongly influenced my decision about the death penalty” ($M = 3.42$, $SD = 1.32$).

Participants slightly agreed with the statement “the defense’s expert testimony regarding the defendant’s genetics helped me understand the defendant” ($M = 3.52$, $SD = 1.50$); slightly disagreed with the statement “the defense’s expert testimony regarding the defendant’s genetics was a blatant attempt to provide an excuse for the defendant’s behavior” ($M = 2.76$, $SD = 1.46$); moderately disagreed with the statement “the defense’s expert testimony regarding the defendant’s genetics was complicated and difficult to understand” ($M = 2.47$, $SD = 1.35$); and slightly disagreed with the statement “the defense’s expert testimony regarding the defendant’s genetics strongly influenced my decision about the death penalty” ($M = 3.02$, $SD = 1.47$).

On average, participants slightly agreed with the following two statements: “physicians can accurately explain how someone’s early childhood experiences may influenced their behavior later in life” ($M = 3.96$, $SD = 1.24$) and “physicians can accurately explain how someone’s genetics may influence their behavior later in life” ($M = 3.63$, $SD = 1.29$).

**Individual Verdicts (Pre-Deliberation)**

A chi square test for independence (with Yates Continuity Correction) was conducted to determine the relationship between the student and community samples for individual verdicts pre-deliberation. Results revealed no significant differences on individual verdicts.
between the samples, $\chi^2 (1, n = 600) = .32, p = .57, \phi = .02$, and it was therefore deemed appropriate to combine the samples to increase power.

Descriptive statistics showed that the Low Dangerousness conditions resulted in fewer death sentences than the High Dangerousness conditions and the G X E conditions resulted in fewer death sentences than either the Genetic, Environmental, or neither Genetic or Environmental (i.e., Control) conditions. Overall, the G X E – Low Dangerousness conditions resulted in the fewest death sentences, as predicted (see Figure 1).

**Figure 1**

*Percentage of Death Sentences within Condition (Pre-Deliberation)*

A direct logistic regression was conducted to determine whether the variables of interest—future dangerousness (Low or High) and explanation of the defendant’s behavior (Control, Environmental, Genetic, or G X E)—could predict individual verdicts pre-deliberation. The full model containing both predictors was statistically significant, $\chi^2 (2, N = 600) = 16.15, p < .001$. The model as a whole explained between 2.7% (Cox and Snell $R^2$) and 3.8% (Nagelkerke $R^2$) of the variance in individual verdicts pre-
deliberation, and correctly classified 70.3% of cases. Both future dangerousness and explanation of the defendant’s behavior provided unique statistically significant contributions to the model (see Table 2). Participants presented with the high risk of future dangerousness evidence were 1.81 times more likely than participants presented with the low risk of future dangerousness evidence to sentence the defendant to death. Participants presented with either the environmental, genetic, or neither environmental nor genetic evidence combined were 1.70 times more likely to sentence the defendant to death than participants presented with the G X E evidence. In sum, results support our predictions, revealing significant main effects for risk of future dangerousness and explanation of the defendant’s behavior on individual verdicts pre-deliberation.

Table 2

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>p</th>
<th>Odds Ratio</th>
<th>95.0% CI for Odds Ratio</th>
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</thead>
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<td>.18</td>
<td>10.51</td>
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<td>.00</td>
<td>1.81</td>
<td>1.27 - 2.60</td>
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<tr>
<td>Explanation Defendant’s</td>
<td>.53</td>
<td>.23</td>
<td>5.36</td>
<td>1</td>
<td>.02</td>
<td>1.70</td>
<td>1.09 - 2.66</td>
</tr>
<tr>
<td>Behavior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
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<td>.13</td>
<td>13.98</td>
<td>1</td>
<td>.00</td>
<td>1.62</td>
<td>- -</td>
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</table>

For exploratory purposes, a direct logistic regression was conducted to compare the G X E – Low Dangerousness condition—the condition that was predicted to be the most mitigating, i.e., result in the fewest death sentences—to each of the other seven conditions. Again, the overall model was significant, $\chi^2 (7, N = 600) = 22.48, p = .002$, explaining between 3.7% (Cox and Snell R square) and 5.2% (Nagelkerke R squared) of the variance in individual verdicts pre-deliberation and correctly classifying 70.3% of cases. Mock jurors in five of the seven conditions were significantly more likely to sentence the defendant to death
than jurors in the G X E – Low dangerousness condition (see Table 3). Of the five conditions that were more likely to sentence the defendant to death than the G X E – Low Dangerousness condition, the only one involving a low risk of future dangerousness was the Genetic condition. This indicates that Genetic conditions, regardless of being accompanied by evidence of a low or high risk of future dangerousness, resulted in an increased likelihood of a death sentence as compared to the G X E – Low Dangerousness condition.

Table 3

Logistic Regression Predicting Pre-Deliberation Juror Verdicts (Exploratory)

<table>
<thead>
<tr>
<th>Condition</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>p</th>
<th>Odds Ratio</th>
<th>95.0% CI for Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>G X E - High</td>
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<td>.44</td>
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<td>1</td>
<td>.02</td>
<td>2.73</td>
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<tr>
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<td>.47</td>
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<td>1</td>
<td>.29</td>
<td>1.64</td>
<td>.66</td>
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<td>1</td>
<td>.01</td>
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<td>1</td>
<td>.00</td>
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<td>1.50</td>
</tr>
<tr>
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<td>1</td>
<td>.00</td>
<td>4.39</td>
<td>1.91</td>
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<td>1</td>
<td>.13</td>
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<td>.82</td>
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<td>1</td>
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<tr>
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<td>.36</td>
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<td>.00</td>
<td>.16</td>
<td>-</td>
</tr>
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</table>

Appropriateness of the Death Penalty (Pre-Deliberation)

An independent samples t-test revealed no significant differences between the student \((M = 2.98, SD = 1.19)\) and community \((M = 2.80, SD = 1.55)\) samples on ratings of the appropriateness of the death penalty pre-deliberation; \(t(598) = 1.61, p = .11\) (two-tailed). It was therefore deemed appropriate to combine samples to increase power.

A two-way between groups analysis of variance (ANOVA) was conducted to explore the impact of future dangerousness and explanation of the defendant’s behavior on jurors’
ratings of the appropriateness of the death penalty pre-deliberation. As predicted, there was a significant main effect for future dangerousness, $F(1, 600) = 6.57, p = .01$; however, the effect size was small (partial eta squared = .01). Specifically, participants in the Low Dangerousness conditions gave lower ratings for the appropriateness of the death penalty ($M = 2.74, SD = 1.38$) than participants in the High Dangerousness conditions ($M = 3.03, SD = 1.38$). However, the main effect for explanation of the defendant’s behavior did not reach statistical significance, $F(3, 600) = 2.06, p = .11$. A means plot reveals that although this main effect was not significant, participants in the G X E conditions found the death penalty to be less appropriate than participants in either the Genetic, Environmental, or Control conditions (see Figure 2).

**Figure 2**

*Mean Ratings of the Appropriateness of the Death Penalty (Pre-Deliberation)*

![Graph showing mean ratings for different conditions](image)

**Jury Verdicts**

42 of the 46 juries that deliberated made a unanimous decision to either sentence the defendant to death or life imprisonment without the possibility of parole (i.e., there were four
hung juries: two in the Control, one in the Environmental, and one in the G X E conditions). Of those 42 juries, none of the juries presented with the G X E evidence sentenced the defendant to death, whereas at least one jury from the Genetic, Environmental, and Control conditions sentenced the defendant to death (see Figure 3). On average, mock jurors had pretty strong agreement with the group verdict ($M = 5.35, SD = 1.17$).

**Figure 3**

*Jury Verdicts*

![Bar chart showing jury verdicts](chart)

**Individual Verdicts (Pre to Post-Deliberation)**

A chi-square test for independence was conducted to determine the relationship between individual verdicts from pre to post-deliberation. Results were significant, $\chi^2 (1, n = 302) = 75.34, p < .001$, with a large effect size ($\phi = .51$), indicating a leniency effect of deliberations: fewer participants voted for death and more participants voted for life after deliberation (see Figure 4).
**Appropriateness of the Death Penalty (Pre to Post-Deliberation)**

A paired samples t-test was conducted to evaluate the impact of deliberation on jurors’ ratings of the appropriateness of the death penalty for the defendant described in the case. There was a statistically significant decrease in ratings of the appropriateness of the death penalty from pre-deliberation ($M = 2.98$, $SD = 1.19$) to post-deliberation ($M = 2.31$, $SD = 1.41$); $t (301) = 9.84$, $p < .001$ (two-tailed). The mean decrease in scores was $.67$, 95%CI [.53, .80]. The eta squared statistic (.24) indicated a large effect size.

**Figure 4**

*Juror Verdicts (Pre to Post-Deliberation)*
CHAPTER V
DISCUSSION

Results supported my hypotheses: a) participants presented with evidence of a low risk of future dangerousness rendered fewer death sentences than participants presented with evidence of a high risk of future dangerousness, b) participants presented with the G X E evidence rendered fewer death sentences than participants presented with the environmental, genetic, and neither environmental nor genetic evidence (combined and averaged), c) across all eight conditions, participants presented with G X E – low dangerousness evidence rendered the fewest death sentences, and d) I witnessed a decrease in the number of death sentences after deliberation.

These results support previous research indicating that a low risk of future dangerousness is likely to function as mitigation while a high risk of future dangerousness is likely to function as aggravation (e.g., Sandys et al., 2010). Results also support previous research suggesting that the deliberation process may induce leniency in criminal cases under certain conditions, known as a leniency effect (e.g., MacCoun & Kerr, 1988).

Importantly, the current study adds to research on the impact of biological evidence on legal decision-makers. My results suggest that evidence of a genetic-environmental interaction may function as mitigation during the penalty phase of capital trials. In fact, it is the combination of genetics and environment, rather than either genetic evidence or
environmental evidence alone, which is particularly meaningful in the context of mitigation. Although Aspinwall et al. (2012) found the MAOA gene to have a mitigating effect on judges’ sentencing decisions, my results indicate that genetic evidence by itself may have an aggravating effect on jurors’ sentencing decisions. The Genetic – Low Dangerousness and Genetic – High Dangerousness conditions resulted in an increased likelihood of a death sentence as compared to the G X E – Low Dangerousness conditions. However, the methodologies of our studies vary: Aspinwall et al. did not manipulate evidence pertaining to the defendant’s risk of future dangerousness and, in the current study, only the defense presented the genetic evidence whereas Aspinwall et al. varied whether this testimony was presented by the prosecution or the defense.
CHAPTER VI
LIMITATIONS, IMPLICATIONS, AND FUTURE DIRECTIONS

The present study involves a simulated death penalty trial and, as such, limits the ability to generalize my findings to actual death penalty trials. It also would have helped to have participants watch an abridged tape of an actual trial or simulated trial rather than read a trial transcript to improve concerns regarding ecological validity. However, a seminal article by Bornstein (1999) on jury simulation research found few differences between mock juror samples (i.e., students vs. community members vs. real jurors) and trial medium (i.e., written summary vs. transcript vs. audiotape vs. videotape vs. live). In fact, the current study found only a small number of differences between the student and community samples on the various dependent variables. Thus, concerns with ecological validity may come more from the courts’ reluctance to accept psycholegal research findings than from issues regarding the mock juror sample or trial medium (Bornstein, 1999).

A more realistic concern stems from the fact that only half of my sample—the student sample—was able to deliberate as a jury, and that there were not enough juries to permit statistical analysis. Nunez, McCrea, and Culhane (2011) argue that the biggest threat to ecological validity in the jury research literature is the dearth of information on deliberating juries. Previous research indicates that deliberations improve the decision-
making process for jurors. For example, deliberating jurors have a better understanding of judicial instructions (Devine et al., 2001) and have better reasoning abilities with respect to case material (McCoy, Nunez, & Dammeyer, 1999). Fortunately, I was at least able to provide descriptive information on my deliberating juries and use the deliberation process to examine a leniency effect.

Ideally, we would have also been able to record the deliberation process and conduct further analyses to better understand how jurors discuss this combination of genetic and environmental evidence. Technical roadblocks prevented this from happening.

In the current study, mock jurors were informed that a previous jury had found the defendant guilty of first-degree murder and that their only job was to make a sentencing decision. However, in actual capital trials, jurors first decide if the defendant is guilty of the capital crime and, if he is, whether he should be sentenced to death or life imprisonment without the possibility of parole. Based on previous research (mentioned earlier) suggesting that capital jurors are biased in favor of the prosecution by the time they reach the penalty phase (e.g., Bowers & Foglia, 2003), it is likely I would have seen more death sentences in my study overall if mock jurors had first decided the defendant was guilty of first-degree murder before deciding whether to sentence him to death or life imprisonment.

It is also possible that the Genetic conditions in the current study were aggravating and the G X E conditions were mitigating as a result of the variations in expert testimony between these conditions. That is, in the G X E conditions, but not in the Genetic conditions, the defense expert—the medical geneticist—testified that the combination of the low-activity
MAOA gene and history of child maltreatment in the defendant were factors outside of his control, which had created a vulnerability toward violent behavior. An expert who emphasizes “factors outside of one’s control” may exert considerable influence over a jury and raises the question of whether the genetic conditions would have been as aggravating had the expert used the same language in both conditions.

Finally, it may be unrealistic to imagine a defendant being described as having a low risk of future dangerousness while at the same time having a combination of genetic and environmental factors that predispose him or her to violence. It would seem that the more likely jurors are to believe the G X E explanation for the defendant’s violent tendencies, the less likely they are to believe the expert’s finding of a low risk of future dangerousness (and vice versa). However, in the current study, jurors in the G X E – Low Dangerousness conditions rated the defendant’s combination of genetics and maltreatment (29.77%) as contributing roughly the same amount as the defendant’s risk of future dangerousness (29.08%) to their decision to sentence the defendant to death. Furthermore, they felt that both the defendant’s genetics and environment ($M = 1.95, SD = .69$) and risk of future dangerousness ($M = 2.17, SD = .83$) made them slightly less likely to sentence the defendant to death. In sum, jurors did not self-report placing more weight on one factor over the other and felt both made them less likely to vote for the death penalty, suggesting that jurors’ chose to settle this apparent contradiction in the experts’ testimony by viewing both pieces of evidence as mitigating. It should also be noted that this pattern was consistent across the Low and High Dangerousness, G X E conditions: participants in the G X E – High Dangerousness conditions reported 29.90% of their decision to sentence the defendant to death was influenced by the G X E explanation and 27.53% was influenced by the defendant’s risk of
future dangerousness. This suggests participants did not dismiss evidence of the defendant’s low risk of future dangerousness altogether, even when presented with evidence of the defendant’s genetics and environment.

Acknowledging these limitations, the present study suggests that evidence of a genetic-environmental interaction may function as mitigation during the penalty phase of capital trials, resulting in a decreased likelihood of a death sentence. It may benefit defense attorneys to consider this as they are in the process of collecting evidence to present as mitigation during trial.

A question for future research is whether this genetic-environmental interaction might also function as a double-edged sword. It may be the case that this combination of evidence, when presented by the prosecution, will also function as aggravation, resulting in an increased likelihood of a death sentence. While the defense can claim genetic and environmental factors have impaired the defendant’s ability to control his behavior, the prosecution can argue these factors show the defendant has a criminal disposition and poses a continued threat to society.

Aspinwall et al. (2012) were able to partially address this question and found that the presentation of genetic evidence by either the prosecution or the defense mitigated judges’ sentencing decisions, though it was more mitigating when presented by the defense. However, results from the current study suggest that the presentation of genetic evidence by the defense has an aggravating effect on jurors’ sentencing decisions. More importantly, it is unknown how the presentation of genetic evidence in conjunction with the presentation of environmental evidence by the prosecution will influence legal decision-makers.
REFERENCES


APPENDIX

University of Colorado
Colorado Springs

Institutional Review Board (IRB) for the Protection of Human Subjects

Date: 9/22/2014

IRB Review

IRB PROTOCOL NO.: 15-024
Protocol Title: You Make the Decision: Jury Judgements in a Death Penalty Trial
Principal Investigator: Ms. Natalie Gordon
Faculty Advisor if Applicable: Dr. Edie Greene
Application: New Application
Type of Review: Expedited 7
Risk Level: No more than Minimal Risk
Renewal Review Level (If changed from original approval) if Applicable: N/A No Change
This Protocol involves a Vulnerable Population: N/A (No Vulnerable Population)
Expires: 21 September 2015

*Note, if exempt: If there are no major changes in the research, protocol does not require review on a continuing basis by the IRB. In addition, the protocol may match more than one review category not listed.

Externally funded: ☒ No ☐ Yes
OSP #: Sponsor:

Thank you for submitting your Request for IRB Review. The protocol identified above has been reviewed according to the policies of this institution and the provisions of applicable federal regulations. The review category is noted above, along with the expiration date, if applicable.

Once human participant research has been approved, it is the Principal Investigator’s (PI) responsibility to report any changes in research activity related to the project:

- The PI must provide the IRB with all protocol and consent form amendments and revisions.
- All advertisements recruiting study subjects must also receive prior approval by the IRB.
- The PI must promptly inform the IRB of all unanticipated serious adverse (within 24 hours). All unanticipated adverse events must be reported to the IRB within 1 week (see 45CFR46.103b(a)). Failure to comply with these federally mandated responsibilities may result in suspension or termination of the project.
- Renew study with the IRB prior to expiration.
- Notify the IRB when the study is complete.

If you have any questions, please contact Research Compliance Specialist in the Office of Sponsored Programs at 719-255-3903 or irb@uccs.edu.

Thank you for your concern about human subject protection issues, and good luck with your research.

Sincerely yours,

Sonja B. Braun-Sand, PhD
IRB Reviewer