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Correlation Between Crime, Oxytocin, and Generosity

Alexa R. Clark
Scripps College

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by

Alexa Rebecca Clark

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PROFESSOR FLYNN
PROFESSOR BARRAZA

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Abstract

This thesis examines the relationship between the type of crime of which an inmate is convicted, the change in oxytocin level, and the level of generosity of that inmate. The level of generosity is measured using a behavioral economics task called the Ultimatum Game. Studies of oxytocin have demonstrated that it is connected to generosity so it is illuminating to study it in conjunction with the generosity measure obtained in the Ultimatum Game. The results of the experiment indicate that there is no correlation between the type of crime of which an inmate is convicted and his generosity level.

Introduction

Significance of this Topic

While only a small percentage of people are diagnosed with psychopathy, its diagnosis, treatment, and the behavior of individuals who are considered psychopaths has far reaching implications. Psychopaths have little or no empathy or sympathy for other people, and view others simply as means to an end to whom anything may be done if it suits the interests of the psychopath. "Psychopathy" has been defined as behavior that combines various antisocial characteristics (Koenigs, Kruepkeb, and Newmanb 2198). For further specificity, psychopathy can be divided into primary and secondary psychopathy, defining primary psychopathy as "(low-anxious) psychopathy [which] is viewed as a direct consequence of some core intrinsic deficit" and secondary psychopathy as "(high-anxious) psychopathy [which] is viewed as an indirect consequence of environmental factors or other psychopathology" (Koenigs, Kruepkeb, and Newmanb 2198).

It is estimated that only one percent of the population are psychopaths (Drum). However, twenty-five percent of men who are incarcerated in federal correctional facilities are psychopaths (Drum). Therefore, this modest percent of the population appears to commit a substantial amount of crimes and use a sizable about of public resources.

Studying criminality and psychopathy is important because it allows people to better understand the behavior of a group of people who have a disproportionately large impact on others (as evidenced by the fact noted above that 25 percent of prisoners are believed to be psychopaths despite psychopaths themselves being only approximately 1 percent of the overall citizenry). Studying differences in OT levels and behavior in the Ultimatum Game can allow people to bet-

ter comprehend the mechanisms behind how psychopaths and criminals make decisions. If people understand why psychopathic prisoners make the decisions that they do, it could be possible to better help them in prison or even prevent them from engaging in harmful behavior before they enter prison. This knowledge can better enable non-psychopathic people to interact with psychopathic people in mutually desired ways. Despite the fact that this thesis examines a very small and unique group of people, it can teach us important lessons about all humans in general because an understanding of the role of oxytocin in people deemed to be psychopaths could help illuminate the role of oxytocin in non-psychopaths as well. In particular, research currently demonstrates the detrimental impacts of lead exposure and future research could determine that the effects of lead may extend beyond reducing neuronal myelination and into either the production of or sensitivity to the oxytocin signals that increase generosity in people not diagnosed with psychopathy.

Given these statistics, many have examined the causes of crime and psychopathy to help understand the triggers of increases and decreases in crime levels to help prevent future unlawful behavior. These attempts to understand the role of psychopathy must be undertaken in the context of the large decrease in U.S. crime rates that took place starting about 1990. A vast array of theories have arisen to explain the decrease of crime at the end of the 20th century, including the "broken windows" theory that espouses the benefits of cracking down on small crimes to stop larger crimes and the theory that *Roe v. Wade* allowed women to delay child rearing until they were better equipped to care for children (Drum).

A more biological explanation for the fall in crime has to do with prenatal and childhood lead exposure. Rick Nevin, a consultant for the US Department of Housing and Urban Development, researched the connection between lead exposure and violent crime after learning of a

study that connected lead exposure and juvenile delinquency (Drum). Graphing the rise and fall of atmospheric lead that was caused by the increase and then decrease of the usage of leaded gasoline yields an inverted U because lead emissions from leaded gasoline quadrupled from the 1940s to 1970s and then fell (Drum). Charting violent crime levels creates the same inverted U as the rise and fall of atmospheric lead but is offset by 23 years (Nevin 16). Nevin's research seems to indicate that individuals who were exposed to high amounts of lead in the 1940s and 1950s as children were more likely to engage in violent crime as they reached their teen years in the 1960 through 1990 time period (Drum).

Nevin's findings merely demonstrate correlation and more evidence would be necessary to indicate causation. Professor Jessica Wolpaw Reyes examined decrease in lead by state and estimated an elasticity between 0.7 and 1.1 indicating that decreases in lead led to significantly less crime (Reyes 32). In addition, several studies have monitored groups of children from before birth to adulthood. Those studies found that higher levels of lead in a child's blood are associated decades later with increased arrests rates for violent crimes (Drum).

In addition to these data, there is neurological research that lead's effects are far-reaching and detrimental. In particular, any amount of lead exposure as a child can negatively impact IQ (Drum). Levels even under 10 μg/dL in children leads to lower reading and learning capabilities, decreased IQ, decreased attention span, hyperactivity, worsened hearing ability, and antisocial behavior (EPA 38). A study of 300 children at the University of Cincinnati ascertained that lead exposure degrades the structure and formation of myelin, which is an insulating sheath on the connections between neurons (Brubaker et al.). Reduced myelin causes neurons to not connect effectively with each other. As a result, the connections within the brain are less coordinated and slower than those in the brains of people with healthy myelin (Brubaker et al.). Childhood lead

exposure is correlated with a permanent loss of gray matter in the prefrontal cortex (Brubaker et al.). The prefrontal cortex is responsible for "emotional regulation, impulse control, attention, verbal reasoning, and mental flexibility" also known as "'executive functions'" (Brubaker et al.). In addition, these neurological detriments appear to be greater in males than in females (Brubaker et al.).

Even minute lead exposure can have negative impacts. Minuscule amounts of lead in blood are associated with attention deficit/hyperactivity disorder, or ADHD (Drum). Combining all the effects of lead at all exposure levels, the literature indicates that lead exposure creates individuals who suffer from aggression, ADHD, lower IQ, and impulsivity (Drum). The effects of lead can push children who might otherwise have been considered slow or disruptive to engage in crime (Drum).

While some might consider lead unimportant as a determinant of future crime rates since leaded gasoline was banned in 1996, lead is surprisingly prevalent even today (Drum). Lead is still in the soil. In fact, in New Orleans, ten separate census tracks have lead levels greater than 1,000 parts per million (Drum). At this level, blood levels reach 7.5 μg/dL which is high enough to have serious negative affects (Drum). This lead in the soil does not remain stationary, but enters the atmosphere through resuspension through heat in the summer (Drum).

There is evidence that lead exposure can lead to psychopathy. The Cincinnati Lead Study examined the effects of lead on individuals who were less than 78 months old on six sub scales of the Psychopathic Personality Inventory and adult psychopathy (Wright, Boisvert, and Vaske 208). Controlling for the impacts of race, gender, mother's IQ, quality of home environment, and child's intellectual achievement, studies revealed that higher blood levels of lead as a child are correlated with higher levels of psychopathic symptoms in adulthood (Wright, Boisvert, and

Vaske 208). Levels of lead in childhood were predictive of Blame Externalization, Impulse Non-conformity, Social Potency, and Machiavellian Egocentricity (Wright, Boisvert, and Vaske 208).

Explanation of the Ultimatum Game

People frequently question their own and other people's motivations for their actions. The Ultimatum Game examines motivations for generosity. This thesis defines generosity as being willing to give more to another person in the Ultimatum Game than the minimum amount one would be willing to accept.

In the traditional Ultimatum Game, the experimenter endows Decision Maker One, or DM1, with a certain amount of money (the endowment) and then DM1 decides how much of the initial allotment to give to Decision Maker Two, or DM2. The experimenters design the game so that DM1 and DM2 do not know with whom they are playing. This anonymity ensures that there is not social pressure to share. The participants know that they are anonymous and they know with how much money the game endows DM1. If DM2 does not believe that DM1 has shared enough money, DM2 can reject DM1's offer and both participants receive no money at the end of the game. However, if DM2 does accept, DM2 receives the amount DM1 offered and DM1 receives an amount that is their initial allocation less the amount he gave to DM2.

If DM2 acts as a rational economic agent, DM2 will accept any positive amount because any positive amount is better than receiving nothing if they reject. If DM1 acts as a rational economic agent, he will give the smallest possible positive increment the game allows; for example, if participants can allocate in increments of pennies, DM1 would give one penny. However, participants do not often behave nearly so rationally. The literature is replete with examples of DM2s rejecting positive offers and DM1s giving more than the minimum positive amount. These

results suggest that forces outside of traditional, rational economic theory can impact people's decisions. In particular, the literature indicates that normal subjects care about fairness and are not purely self-interested. Normal DM1s often offer exactly half the endowment to the DM2 with whom they are paired off and nearly all DM1s offer at least some of the endowment to the DM2s with whom they are paired off.

The Dictator Game is another game designed to examine generosity. It is similar to the Ultimatum Game but has a crucial difference. In the Dictator Game, DM2 must accept however much DM1 offers. Thus, DM1s do not have to fear DM2s rejecting offers. A purely rational person who only wanted to maximize his own earnings would, in such as situation, allocate all of the endowment to himself. But normal subjects do not do that. Offers in fact are smaller than in the Ultimatum Game (where rejection by DM2s is possible) but nearly all DM1s in the Dictator Game allocate at least some of the endowment to the DM2 with whom they are paired off. So even in this very one-sided game in which one participant is totally helpless and in which the person with all the power is anonymous and thus has no fear of negative repercussions, normal subjects still manifest behavior indicative of a deep concern for fairness and equality.

Overview of Studies of the Ultimatum Game

There is an extensive literature on inmate behavior in economic games that measure prosociality. One subgroup of prisoners that economists have examined is prisoners who have been categorized as psychopaths. People diagnosed as psychopaths play the game in a statistically differently manner than control groups (Koenigs, Kruepkeb, and Newmanb 2010). Secondary psychopaths "exhibited significantly reduced Ultimatum acceptance rates as well as significantly

lower Dictator offers" when compared to secondary psychopaths and non-psychopaths (Koenigs, Kruepkeb, and Newmanb 2010).

Researchers have examined the Dictator Game and the Ultimatum Game in conjunction with oxytocin, or OT. OT is a "neuroactive hormone" that "instantiates empathy and promotes prosocial behaviors" (Zak and Barraza). It is illuminating to study OT in conjunction with economics since sharing one's money with others can be interpreted as an act of trust and generosity, both of which are types of actions in which OT is considered to play a vital role. In 2007, Zak et al. created an experiment to determine if differences in the gene relating to the oxytocin receptor could predict differences in behavior and if an infusion of OT could make people more generous in the game (Zak, Stanton, and Ahmadi). This study found that oxytocin impacted generosity twice as much as altruism (Zak, Stanton, and Ahmadi).

The Ultimatum Game is a unique tool to analyze human behavior. It forces participants to assess the lowest amount of money they think another person will accept relative to a predetermined allotment. There is a cost to underestimating because if DM1 underestimates how much the other person will accept, neither participant receives any money. There is also a cost to overestimating because, in this circumstance, DM1 gave more than necessary to have the offer accepted. The person receiving the allocation offer must ascertain whether the amount is high enough to accept and to allow the other participant to keep their portion. These decisions are complex because one must determine their own preferences and the preferences of someone whom they have never met.

The recent addition of studying OT in conjunction with economic decision making has shed light on some of the mechanisms behind generosity. Examining OT levels facilitates discussions that would not be possible within the traditional scope of economics. It is beneficial to ex-

plore OT's role in behavioral economics games since OT production is associated with generous behavior and sacrifice.

Literature Review

Importance of Oxytocin

Many studies have delved into OT and its genetics while simultaneously examining the Ultimatum Game. It is illuminating to study OT in conjunction with the Ultimatum Game because the Ultimatum Game "illustrates costly altruistic behavior" (Israel et al.). In addition, Israel et al. conducted an experiment to ascertain if "the gene encoding the related oxytocin receptor (*OXTR*) was...[associated] with the [Dictator Game] and a related paradigm, the Social Values Orientation (SVO) task" (Israel et al.). The authors determined that OXTR is associated with prosocial behavior in the Dictator Game. They found the manner in which people allocated funds in the Dictator Game was "in part determined by the length of the arginine vasopressin 1a (AVPR1a) RS3 promoter region repeat region" (Israel et al.). Furthermore, "the length of the RS3 repeat region was correlated with increased amounts of AVPR1a mRNA in hippocampal post-mortem specimens" (Israel et al.). The results from this study indicate that there could be biological reasons for differences in levels of generosity. Israel et al. determined that "[i]ndividual differences in prosocial behavior have been shown by twin studies to have a substantial genetic basis" (Israel et al.). Therefore, it can be important to study genes in conjunction with generosity. Israel et al. demonstrated that, with respect to genetic differences, "common variants in the oxytocin receptor gene, an important element of mammalian social circuitry, underlie such individual differences" (Israel et al.). The oxytocin receptor is "a typical class I G

protein-coupled receptor that is primarily coupled via G(q) proteins to phospholipase C-beta" (Gimple and Fahrenholz). Therefore, this gene and its relationship with oxytocin could explain a great deal of variation in generosity.

The evidence indicates that oxytocin can act as a mechanism for generosity and that generosity can alter behavior in decisions making in situations such as the Dictator Game and Ultimatum Game. From the studies, there does not appear to be much disagreement about the relationship between oxytocin and generosity. Various authors have found that oxytocin increases people's willingness to sacrifice money in decision making games.

Psychopathy and the Ultimatum Game

The literature on psychopathy illuminates the disparity in behavior between people who are diagnosed with primary psychopathy with those who are diagnosed with secondary psychopathy. It further demonstrates differences in behavior between those who are on the psychopathy spectrum and those who are not. Koenigs et al. examined

> whether the different subtypes of psychopathy (primary vs. secondary) are associated with characteristic patterns of economic decision-making, and furthermore, whether either subtype exhibits similar performance to patients with [ventromedial prefrontal cortex, or] vmPFC[,] lesions (Koenigs, Kruepkeb, and Newmanb 2218)

To determine which participants were deemed psychopaths, the authors used the Psychopathy Checklist-Revised, or PCL-R (Koenigs, Kruepkeb, and Newmanb 2199). Participants whose scores were above 30 were categorized as psychopaths whereas participants whose scores were below 20 were not (Koenigs, Kruepkeb, and Newmanb 2199). To separate the participants categorized as psychopaths into subgroups, "primary (low anxiety) psychopathy was differentiated from secondary (high anxiety) psychopathy based on a median split of Welsh Anxiety Scale

(WAS) scores" (Koenigs, Kruepkeb, and Newmanb 2199). A median split changes a continuous variable into a binary value by categorizing results above the median as high and results below the median as low.

When asking people on the psychopathic spectrum to participate in the economic decision making tasks, the authors found that people with primary psychopathy have much lower acceptance rates of unfair Ultimatum Offers and they offered lower amounts in the Dictator Game (Koenigs, Kruepkeb, and Newmanb 2198). Linking most behavioral differences between people deemed psychopaths by the PCL-R and those not categorized as psychopaths to stem from primary psychopathy, the results indicated that primary psychopathy is associated with lower acceptance rates of unfair offers in the Ultimatum Game and lower offer amounts in the Dictator Game (Koenigs, Kruepkeb, and Newmanb 2200). Koenigs et al. demonstrate that the actions of people with primary psychopathy deviate substantially from those who are not considered psychopaths.

Furthermore, the authors compared participants' behavior with the actions of patients who have ventromedial prefrontal cortex (vmPFC) lesions. They chose these patients because the vmPFC "plays a critical role in affective processing" (Koenigs, Kruepkeb, and Newmanb 2199). Affective processing is how people process emotional information cognitively and neurally. Studying affective processing is important for examining psychopathy because secondary psychopathy is "thought to arise as an acquired disturbance of social and affective processing" (Koenigs, Kruepkeb, and Newmanb 2198). This disturbance is considered "an indirect consequence of environmental or psychological factors such as parental abuse, socioeconomic disadvantage, poor intellect, substance abuse, or neurotic anxiety" (Koenigs, Kruepkeb, and Newmanb 2198). There was not a statistically significant difference between the acceptance rates of

primary psychopaths and the acceptance rate of patients with vmPFC lesions (Koenigs, Kruepkeb, and Newmanb 2201). This result indicates that lesions in the vmPFC can cause behavior similar to the actions of people who have primary psychopathy.

Prisoners and the Behavioral Economics Games

In their study of prisoners, Gummerum and Hanoch discovered that "[i]nmates gave significantly more money than non-inmates in the [D]ictator [G]ame" (Gummerum and Hanoch 68). They also determined that "inmates, more than non-inmates, tended to give half [and] conversely, they tended to give zero less often than non-inmates" (Gummerum and Hanoch 68). Gummerum and Hanoch's findings indicate wider disparity in giving between inmates than between non-incarcerated individuals. Furthermore, inmates demonstrated "higher empathic concern, $t(98) = -3.36$, $p = 0.001$, and marginally significantly higher perspective taking, $t(98) = -1.98$, $p = 0.06$, than non-inmates" (Gummerum and Hanoch 68). Gummerum and Hanoch measured empathic concern and perspective-taking by using the subscales of the Interpersonal Reactivity Index (Gummerum and Hanoch 68). All the subscales

> consisted of seven items (e.g. perspective taking: "When I'm upset at someone, I usually try to put myself in his shoes for a while"; empathic concern: "I am often quite touched by things that I see happen"), which are rated on a 5-point Likert-type scale ranging from (1) *does not describe me well* to (5) *describes me very well*.

These results illustrate that altruism is present in both groups. The final results were that inmates gave around fifty percent of their money and non-inmates gave round thirty-three percent (Gummerum and Hanoch 71).

In their examination of the connection between selfishness and crime, Chmura et al. discovered that "prisoners do not give less than members of the general public in the dictator game" (Chmura, Engle, and Englerth 15). They rejected their hypothesis that prisoners would donate

less than non-prisoners and also found that “in the Dictator Game prisoners do not give less than members of close-knit groups” (Chmura, Engle, and Englerth 17). This study engaged in a meta study of close-knit groups and an example of close-knit groups were “randomly assigned army groups” (Chmura, Engle, and Englerth 28). Moreover, in a study of the morality of prisoners, Birkeland et al. used the Dictator Game to illustrate that “the prisoners are highly motivated by pro-social preferences...and that there are no differences in the sharing behavior of the prisoners and the benchmark group” (Birkeland, Cappelen, Sørensen, and Tungodden 9). The results from these two studies indicate that prisoners engage in moral behavior and act on pro-social preferences.

Sources of Error in the Literature Studied

While the fact that convicted criminals gave a higher percentage than non-inmates could indicate that they are more altruistic, studying incarcerated individuals has many sources of error. For instance, the inmates might have believed that prison personnel were monitoring their behavior (Gummerum and Hanoch 73). In addition, prisoners might feel the need to give more than they naturally would to counteract stereotypes of prisoners or because they have fewer opportunities to behave altruistically relative to people outside of prison (Gummerum and Hanoch 73). All of these factors could skew the data to indicate that prisoners are more altruistic than they truly actually are. The articles do agree, however, that inmates frequently give as much or more than non-inmates in the Ultimatum Game. It is difficult to compare the data from the papers, though, because they used different metrics and sometimes even different versions of the Ultimatum Game.

In addition, none of the papers previously mentioned analyzed the oxytocin levels of their participants. Oxytocin, or OT, is studied as a mechanism for generosity. Paul Zak et al. infused participants with OT to see if they behaved more generously than the participants who did not receive OT (Zak, Stanton, and Ahmadi). The authors found that participants "on OT were 80% more generous than those given a placebo" (Zak, Stanton, and Ahmadi). OT does not operate alone, however. This was evidenced by the fact "OT had twofold larger impact on generosity compared to altruism" but "OT and altruism together predicted almost half the interpersonal variation in generosity" (Zak, Stanton, and Ahmadi). Generosity was measured by the Ultimatum Game with "a blinded, one-shot decision on how to split a sum of money with a stranger that could be rejected" (Zak, Stanton, and Ahmadi). The findings of this paper indicate that oxytocin can impact levels of generosity. In a related paper, Morhenn et al. discovered that touch increases oxytocin which then results in higher amounts of monetary sacrifice (Morhenn et al. 375).

Overview of the Experiment

This thesis examines the data of inmates classified as psychopaths according to the Psychopathy Checklist-Revised, or PCL-R. The PCL-R includes an hour to hour-and-a-half interview and a review of the inmate's file (Koenigs, Kruepkeb, and Newmanb 2199). The PCL-R involves rating characteristics related to psychopathy as a 0, 1, or 2 depending on how closely the person exhibited that trait (Koenigs, Kruepkeb, and Newmanb 2199). Inmates in the sample have been convicted of a range crimes. They participated in a version of the Ultimatum Game while in a secured facility. Before and after playing the Ultimatum Game, the experimenters obtained blood samples to determine the change in oxytocin levels of the participants.

This thesis seeks to determine if the crime for which an inmate is convicted is correlated with how much a DM1 gives in the Ultimatum Game. The measure of how much a DM1 gives is recorded as a level of generosity because it is measured against the lowest amount the DM1 said he would be willing to accept if he were in the DM2 position before the game commenced. If a DM1 gives more than the initial value he stated as his minimum, he is considered to have positive generosity and he is considered to have negative generosity if he gives less. To determine the correlation between change in oxytocin level and the amount offered and the crime of which an inmate is convicted and the amount offered, I will use regression analysis with one regression for change in oxytocin level and one regression for type of crime.

Modeling Section

Details of the Experiment

The study I am using examined 147 participants who were inmates at a secure treatment center in the United States. The study occurred in the summer of 2012. Participants were paid at least minimum wage, which was $7.25 per hour. All participants earned between $7.25 and $20. If at the consent appointment it was determined that a participant was ineligible or if the participant decided not to participate, the participant earned $7.25 for attending the appointment. The participant's earnings were deposited into their institutional account. The inmates at this facility are heavily monitored and there is often a one-to-one ratio between the prisoners and the prison personnel. The participants engaged in an economic decision task. The task was a version of the Ultimatum Game in which DM1s were asked to propose splitting $20 endowment. Each participant actually played against himself but believed that he was playing against another inmate. Before the game began, the participants indicated the minimum amount they would be willing to

accept in the Ultimatum Game before learning if they were the sender or receiver. Then they played the game. Since each participant was playing himself, the lab obtained a measure of generosity. The lab deemed participants who gave more than the minimum they were willing to accept as demonstrating positive generosity and those who gave less than the minimum they were willing to accept as illustrating negative generosity. After participating in the Ultimatum Game, participants viewed a video of children in need and then had the opportunity to donate money from what they had just earned to St. Jude to help children like those they had seen in the movie. The variables I examined are IQ, age, marriage status, dating status, and number of friends.

Regression Analysis

I ran regressions to determine if the type of crime of which an inmate is convicted is correlated with the amounts sent and donated, the percentage sent and donated, and the level of generosity. I used the beta coefficient on the crime variable and its level of statistical significance to determine if correlation exists and, if so, the magnitude and direction of its impact. I used the Ordinary Least Squares regression since it produces the Best Linear Unbiased Estimator and I do not currently have any reason to believe that this type of regression would provide an inaccurate representation of the data. Using OLS regressions allowed me to control for certain factors. I will use interaction variables including IQ*Age and IQ*Number of Friends. I believe that by controlling for these I am better able to determine the correlation between the type of crime of which a person is convicted and his amount sent and donated. Since the data I have has general information about the type of crime, I used a dummy variable which is one if the person is convicted of that type of crime and zero if not. Given the information concerning lead's connection with

psychopathy, I ran a regression to see if participants who are older and more likely to have been exposed to lead have higher PCL-R scores. I ran a regression to see if any of the factors I selected as controls influenced the generosity measure. To do these regressions I used SPSS Statistics.

It can be useful to examine the distribution of the variables. In the group of inmates who participated in the study, the mean age was 47.5 and the median age was 46.0. The minimum age was 26.0 and the maximum age was 79.0. The mode age was 41.0. IQ was measured by the institution and it is not known what test they used. The mean IQ was 97.34 and the median was 95.0. The minimum IQ was 75.0 and the maximum IQ was 153.0. The mode IQ was 91.0.

The number of friends measure is obtained by asking participants how many close friends they have. The mean number of close friends was 4.4 and the median was 4.0. The mode was 2.0. The minimum number of close friends was 0 and the maximum was 20.0. Furthermore, 6 of the participants were married and 34 were dating. The mean PCL-R score was 20.8 and the median score was 21.0. The minimum PCL-R score was 7.0 and the maximum score was 34.0. There were 10 participants who had scores over 30 and would therefore be classified as psychopaths. Furthermore, there was variation in the number of participants who had been convicted of each type of crime. 63 of the 147 participants had been convicted of child sexual abuse, 86 had been convicted of rape or attempted rape, 40 had been convicted of non-rape sexual assault, and 52 had been convicted of a non-violent sex offense.

The amount sent was the amount the participant chose to give to the other participant in the Ultimatum Game. The mean amount sent was $9.63 and the median was $10.00. The mode amount sent was $10.00. The minimum amount sent was $0 and the maximum was $20.00. The

mean percent sent was 48.2 and the median was 50.0. The mode percent sent was 50.0. The minimum percent sent was 0 and the maximum percent sent was 100.

The amount donated was the amount the participant chose to donate to St. Jude. The mean amount donated was $4.93 and the median was $5.00. The mode amount donated was $5.00. The minimum amount donated was 0 and the maximum amount donated was $15.00. The mean percent donated was 51.1 and the median percent donated was 50.0. The mode percent donated was 100. The minimum percent donated was 0 and the maximum percent donated was 100. The maximum amount any participant could have donated was $20.00 since that was the most it was possible to earn.

The generosity measure was calculated by subtracting the amount that the participant had set as his minimum acceptable threshold from the amount that participant sent. The mean generosity level was 3.4 and the median was 2.0. The mode generosity level was 0. The minimum generosity level was -20.0 and the maximum generosity level was 25.0. The mean change in oxytocin was -0.4188 µg and the median was 0.04 µg. The mode change was 0 µg. The minimum was -73.27 µg and the maximum was 26.7 µg.

None of the regressions yielded a high R^2. My model formed by the variables I selected predicted 37.2 percent of the change in generosity, 8.4 percent of the change in oxytocin, 16.8 percent of the change in percent donated, 12.9 percent of the change in amount donated, 8.9 percent in amount sent, and 8.9 percent in percent sent. These results are demonstrated in tables 1 through 9. Unfortunately, very few of the coefficients in the regressions were statistically significant at the five percent level. It is intriguing that the model predicted generosity more than any other variable. In this regression, only IQ*Age, IQ*Friends, and IQ were statistically significant.

The variables might not have explained much of the variation in the dependent variables due to omitted variable bias. There is also the possibility that perhaps the independent variables explain more about certain segments of the inmates than of the inmates as a whole. I used PCL-R categories, having category 1 be 0 to 9.9, category 2 be 10 to 19.9, category 3 be 20 to 29.9, and category 4 be 30 and above to see if the variables were more explanatory for inmates with certain PCL-R scores. Categories 1 and 4 did not have enough participants to yield significant results, but categories 2 and 3 did (Tables 6 and 7). The R^2 were higher for categories 2 and 3 PCLR scores than for the group as a whole. I tested to see if age increased PCL-R score (considering that older inmates were more likely to have been exposed to lead) but the results did not indicate that age influenced PCL-R (Table 5).

Conclusion

These low R^2 values and the fact that very few variables were statistically significant indicate that this model formed by my variables does not explain much of the variation the amount sent or donated, the percent sent or donated, or the level of generosity. These results are intriguing in that they indicate that the factors that influence an inmate's decision to send or donate number are not related to the type of crime of which they are accused. In addition, the age did not appear to be factor of the PCL-R in the group of individuals examined. This result is different than what the literature would suggest. The results could have been skewed due to the fact that there were very few participants in certain categories.

Possible explanations for the low R^2 values are that there could be factors of criminality that are difficult to quantify and to define. These include type and level of abuse the inmate might have received, quality of care provided by parents, and stability of home life. For age not

being a factor in PCL-R for this group, it is possible that where the inmates currently housed in the facility lived as children enabled them to receive less exposure to lead than other people their same age. The PCL-R of the group could be driven by factors other than lead exposure, such as early childhood experiences and education.

This topic boasts many areas for future research. Research that could illuminate the nature of psychopathy and generosity further are studies examining at what age people begin to display the characteristics of psychopathy, if psychopathy is hereditary, and if early detection and intervention mitigates the impacts of psychopathy.

Appendix

TABLE 1: Percent Sent	Constant	-0.311	-0.776
	Age	0.568	-0.016
	IQ*Age	-0.942	(0.00)’
	IQ*Friends	-0.124	(0.00)’
	IQ	0.616	-0.008
	Friends	0.159	-0.043
	Married	0.005	-0.148
	Dating	0.084	-0.046
	PCLR-Categories	0.056	-0.048
	PCLR	0.026	-0.008
	Sexual Assault-Child	0.044	-0.043
	Rape	0.113	-0.053
	Non-Rape Sexual Assault	0.03	-0.044
	Non-Violent Sex Offense	-0.055	-0.04
	R^2	0.089	
	Adjusted R^2	-0.045	

TABLE 2: Sent	Constant	-6.22	-15.523
	Age	0.568	-0.316
	IQ*Age	-0.942	-0.003
	IQ*Friends	-0.124	-0.009
	IQ	0.616	-0.154
	Friends	0.159	-0.859
	Married	0.005	-2.955
	Dating	0.084	-0.916
	PCLR-Categories	0.056	-1.352
	PCLR	0.026	-0.15
	Child Sexual Abuse	0.044	-0.865
	Rape	0.113	-1.052
	Non-Rape Sexual Assault	0.03	-0.876
	Non-Violent Sex Offense	-0.055	(0.7950
	R^2	0.089	
	Adjusted R^2	-0.045	

TABLE 3: Donated	Constant	-12.676	-13.683
	Age	0.6	-0.272
	IQ*Age	-0.863	-0.003
	IQ*Friends	-1.147	-0.008
	IQ	0.778	-0.136
	Friends	1.048	-0.768
	Married	0.012	-2.704
	Dating	0.15	-0.833
	PCLR-Categories	-0.113	-1.232
	PCLR	0.137	(-0.011)
	Sexual Assault-Child	0.046	-0.792
	Rape	0.102	-0.953
	Non-Rape Sexual Assault	-0.123	-0.797
	Non-Violent Sex Offense	-0.055	-0.72
	R^2	0.129	
	Adjusted R^2	0.003	

TABLE 4: Percent Donated	Constant	-1.311	-1.37
	Age	0.548	-0.027
	IQ*Age	-0.878	(0.000)’
	IQ*Friends	-0.926	-0.001
	IQ	0.821	-0.014
	Friends	0.801	-0.079
	Married	0.004	-0.271
	Dating	0.203	-0.083
	PCLR-Categories	-0.082	-0.123
	PCLR	-0.022	-0.014
	Sexual Assault-Child	0.063	-0.079
	Rape	0.119	-0.095
	Non-Rape Sexual Assault	-0.058	-0.08
	Non-Violent Sex Offense	-0.06	-0.072
	R^2	0.168	
	Adjusted R^2	0.048	

TABLE 5: Change in Oxy-tocin	Constant	5.39	-14.932
	Age	0.307	(-0.021)
	IQ*Age	0.003	-0.023
	IQ*Friends	0.004	-0.008
	IQ	0.149	(-0.086)
	How Many Close Friend	0.803	(-0.557)
	Married	-0.037	-2.781
	Dating	0.886	(-0.046)
	PCLR	0.065	(-0.005)
	Convicted of Child Sexual Abuse	0.839	(-0.237)
	Convicted of Rape or Attempted Rape	1.038	(-0.083)
	Convicted of Non-Rape Sex-ual Assault	0.855	(-0.146)
	Convicted of Non-Violent Sex Of-fense	0.776	-0.08
	R^2	0.084	
	Adjusted R^2	-0.063	

TABLE 6: Generosity	Constant	-28.87	-23.514
	Age	0.882	-0.471
	IQ*Age	-0.915	-0.005
	IQ*Friends	-0.363	-0.013
	IQ	0.421	-1.355
	How Many Close Friend	-0.037	-4.656
	Married	-0.037	-4.656
	Dating	0.018	-1.446
	PCLR	-0.139	-0.109
	Convicted of Child Sexual Abuse	0.149	-1.376
	Convicted of Rape or Attempted Rape	0.257	-1.673
	Convicted of Non-Rape Sex-ual Assault	-0.002	-1.356
	Convicted of Non-Violent Sex Of-fense	-0.166	-1.245
	R^2	0.372	
	Adjusted R^2	0.138	

TABLE 7: Sent-2nd Category PCLR	Constant	-17.417	-18.868
	Age	1.868	-0.412
	IQ*Age	-2.263	-0.004
	IQ*Friends	-0.208	-0.004
	IQ	1.148	-0.179
	Friends	0.398	-1.185
	Married	-0.084	-3.9
	Dating	0.142	-1.309
	PCLR	0.11	-2.6
	Non-Rape Sexual Assault	-0.008	-1.487
	Rape	-0.02	-1.537
	Non-Violent Sex Offense	0.015	-1.2
	R^2	0.138	
	Adjusted R^2	-0.244	

TABLE 8: Sent-3rd Category PCLR	Constant	-4.335	(-4.335)
	Age	0.636	-0.186
	IQ*Age	-0.552	-0.006
	IQ*Friends	-0.256	-0.016
	IQ	0.328	-0.528
	Friends	0.213	-1.557
	Married	0.089	-4.458
	Dating	-0.004	-1.337
	PCLR	0.029	-0.186
	Non-Rape Sexual Assault	0.21	-1.277
	Rape	-0.001	-1.553
	Non-Violent Sex Offense	-0.034	-1.134
	R^2	0.224	
	Adjusted R^2	-0.009	

TABLE 9: PCLR			
Constant	Age	R^2	Adjusted R^2
21.613	-0.028	0.001	-0.007
(2.532)	(0.053)		

TABLE 10: Section One of Demographics					
Variable	Mean	Median	Mode	Minimum	Maximum
Age	47.5	46.0	41.0	26.0	79.0
IQ	97.34	95.0	91.0	75.0	153.0
Close Friends	0	20.0	2.0	0.0	20.0
PCL-R	20.8	21.0	21.0	7.0	34.0
Amount Sent	$9.63	$10.00	$10.00	$0.00	$20.00
Percent Sent	48.2%	0.50%	0.50%	0%	100%
Amount Donated	$4.93	$5.00	$5.00	$0.00	$15.00
Percent Donated	51.1%	50.0%	100%	100%	100%
Generosity Level	3.4	2.0	0	-20.0	25.0
Change in Oxytocin	-0.4188	0.0400	0.00	-73.27	26.70

TABLE 11 Section Two of Demographics	
Category	Number of Participants
Convicted Child Sexual Abuse	63
Convicted of Rape	86
Convicted of Non-Rape Sexual Assault	40
Convicted of Non-Violent Sex Offense	52
Married	6
Dating	34

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