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Childhood Trauma, a Cycle of Violence: Worcester, MA

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Childhood Trauma, a Cycle of Violence: Worcester, MA
A quantitative analysis of early police contact on violence, criminal activity, and gang involvement

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Abstract

This research examines the relationship between childhood trauma, indicated by early police contact, and the probability of later negative life experiences, including involvement in and perpetration of violence, criminal activity and gang involvement for men age 0-27 in Worcester, MA. This research was conducted using probit and tobit regression analysis using the Worcester Police Dataset. This study shows a positive and highly statistically significant correlation between childhood trauma and gang involvement as well as involvement in violence, perpetration of violence, and the number of incidents of violence. This suggests that a crisis intervention for childhood trauma, including witness-based childhood trauma, may help to break cycles of violence in the future.

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Statement of Purpose

A distinct relationship between childhood trauma and an increased risk for criminal activity, gang involvement, and violence later in life would suggest that an incident based intervention at the time of trauma may be a useful prevention strategy in reducing future violence. Reducing youth crime and gang violence has been identified as a top priority of the City of Worcester. The city has received funding from the Shannon Community Safety Initiative to implement a "multi-disciplinary anti-gang strategy encompassing prevention, intervention, and suppression programs utilizing law enforcement, community-based organizations, and government agencies" (City of Worcester, 2012). This research will support violence prevention efforts that seek to reduce the negative consequences of trauma through early intervention by understanding the long-term consequences of such traumas through a quantitative analysis. Developmental psychologists show that trauma during childhood and adolescence can negatively impact brain development and result in aggressive behavior through damage to the limbic system (Dahlberg and Potter, 2001). By showing the correlation between a single event of early police contact, which we call traumas, and gang involvement, violence, and criminal activity for males in Worcester, this research demonstrates a need for intervention that may prevent or reverse this correlation and reduce violence and crime in the next generation.

This research examines the relationship between early police contact for witnessing or victimization before age 12 and criminal activity, gang involvement, involvement in violence, and perpetration of violence in males ages 0-27 based on the police database of

Worcester, MA. The quantitative analysis will first seek to understand the relationship between childhood trauma and criminal activity more broadly, followed by a deeper analysis which will examine the type of offense, isolating violent offenses, and finally an analysis of the relationship between childhood trauma and gang involvement controlling for race, age, and gender. For the purpose of this research, childhood trauma is defined as an incident of police contact as a victim or witness of a criminal incident before the age of 12. This research works within the framework of the developmental risk theoretical model, rather than cumulative risk model, meaning that it seeks to understand the effect of a single traumatic experience instead of the accumulation of negative or stressful life events because of the nature of our dataset (Gerard and Buehler, 2004). In general, a breadth of research exists within the developmental risk theoretical framework on the relationship between a traumatic event (such as abuse) and later delinquent or criminal activity (Maschi, 2006). Yet, there remains a gap in the research in the linkage of childhood trauma and gang involvement and no quantitative analyses of this type have been implemented in Worcester, MA. This paper will fill this gap, expanding the understanding of the link between childhood trauma and criminal activity and specifically examining the correlation between childhood trauma, gang involvement, and violence.

The correlation between childhood trauma and the dependent variable, *involvmenet in violence, perpetration of violence, gang involvement,* and *criminal activity* will be examined using bivariate probit models. The understanding of trauma as an isolated event and chronic or repeated trauma will be expanded through the introduction of categorical

variables for the number of childhood traumas recorded in the dataset. Understanding whether the subject's role as a witness or victim during the childhood trauma will be explored using a bivariate probit model with categorical independent variables for witness-based trauma, victim-based trauma, and both witness-and victim-based trauma.

This research will work within the limitations of a police dataset where individual names have been redacted. As such, certain information, such as the individual's place of residence, socioeconomic status, criminal history outside of Worcester, and more will not be available and will therefore limit the study. Working within the limitations of the dataset, the modeling will still be useful in informing future violence prevention and trauma intervention efforts in the city. This is a conservative attempt at modeling due to the limitations. We suspect that any correlations found in this analysis would be stronger and more robust with a more comprehensive dataset.

Conceptual Framework

Expansive literature exists which demonstrates the positive correlation between childhood maltreatment and increased risk of delinquency. Studies of this nature serve as the broad basis for understanding the existence of a link between childhood trauma and gang involvement, which is examined in some of the literature. Kerig et al. (2013) suggest that studies of gang involvement in the United States should be framed in a way that parallels international studies of child soldiers, linking both family structure and trauma to self-agency. Some studies examine these factors as controls to isolate the effect of trauma

(Maschi, 2006), while others frame social factors such as poverty, unemployment, family structure, and social dislocation as the main contributors to youth gang involvement (Hagedorn, 1988). There is, however, a lack of understanding in the literature of the relationship between traumatic incidents and gang involvement (Kerig, et al. 2013). This research works within the framework of the developmental, also known as differential risk theoretical model, rather than cumulative risk theory, meaning that it seeks to understand the effect of a single traumatic experience rather than the accumulation of negative or stressful life events (Gerard and Buehler, 2004). However, it is important to examine quantitative studies that have taken both developmental and cumulative risk approaches in understanding risk factors for delinquency and violence to inform the methodology, analysis, and limitations of this research.

Braaten-Antrim and Thompson (1998) examine the relationship between youth maltreatment, as measured by sexual and physical abuse, and gang involvement, as measured by the number of times involved in a "gang fight" using cross-sectional panel data and logistic regressions. All variables are self-reported survey results of 6^{th}-12^{th} graders. They found that physically maltreated youth were 2.35 times ($p<0.05$) more likely to be gang involved than non-physically maltreated youth controlling for grade level, gender, race, and family structure (Braaten-Antrim and Thompson, 1998). This study quantifies a relationship in the short term between self-reported maltreatment and self-reported gang involvement using a developmental framework but is restricted to individuals still in High School.

Maschi (2006) uses logistic regression analysis to examine the cumulative and differential effects of trauma on delinquency among males age 12-17 using a nationally representative sample collected by phone interviews. Maschi controls for possible confounding variables, including race, age, socioeconomic status, family structure, peer effects, and social support to isolate the effects of trauma on delinquency. Using a hierarchical logistic regression analysis, Maschi finds that both cumulative and differential measures of trauma, or measures that account for an accumulation of trauma versus a single incident, are positively correlated to both property offending and violent offending delinquency, statistically significant at the 1% level (Maschi, 2006). Further, the models revealed that victims and witnesses of physical trauma (assault) are far more likely to perpetrate violence (Odds Ratio = 1.4, $p<0.01$), as well as a link between noncriminal trauma, such as school failure, and violence (Odds Ratio = 1.17, $p<0.01$) (Maschi, 2006). The control variables for race and socioeconomic status also appeared to have a correlation with delinquency where lower income and minority individuals were at higher risk for delinquency. This, again, suggests the importance of socioeconomic status and race in models used to predict delinquency, and in this paper to predict gang involvement and violence.

Gerard and Buehler (2004) use data from the National Longitudinal Study of Adolescent Health to examine the relationship between cumulative risk exposure and problem behavior. This study seeks to understand whether the total effect of individual risk factors is greater than the sum of their individual risks looking exclusively at four social domains: family, peer, school, and neighborhood. They found that cumulative risk has a

steady, negative influence on problem behaviors in adolescents, factors which should be considered as limitations in this research as the necessary information to understand cumulative risk is not included in the Worcester Police Dataset and therefore will not be considered in the study of childhood trauma and gang involvement but likely have an effect on youth gang involvement.

In a comprehensive study "Youth Violence, Juvenile Crimes, and Youth Gangs in Utica, NY," Darman, et al. (2005) use a mixture of quantitative and qualitative measures to examine the many factors of gang involvement. While Darman, et al. do conclude that when a child experiences domestic violence they are more likely to both join a gang and engage in violence, they also suggest that experiencing violence may not be limited to our definition of trauma and could include exposure to violence through the media, the neighborhood, and through pop culture (Darman, et al., 2005, 32). In addition, their study suggests a strong link between mental health and gang involvement/ violence, a factor that has not been considered in the above studies and will not be a variable in our study due to data limitations but is a strong factor for consideration when thinking about the implications of this research.

Eitle et al. (2004) use a cumulative risk model that considers violence, trauma, and a number of life stressors. They found that preteen stress exposure is an independent risk factor for gang involvement ($p<0.01$), but that this exposure may be mediated or worsened by other factors. This notion that the effect of trauma may be mitigated for some individuals is supported by Garbino (2001) who explains that a child may be able to recover from the effect of a trauma with enough "salutogenic," or positive influences.

Oppositely, Garbino explains that children living in "urban war zones" often have a dismantling of salutogenic factors and a high exposure to "pathogenic," or negative influence which negatively effect the child's development and can exacerbate the negative effects of trauma (Garbino, 2001, 363). While some studies consider salutogenic and pathogenic factors as controls their presence is often difficult to measure through both surveys and interviews and is largely impossible when using police data, therefore, only known control factors will be considered.

Studies have taken many different approaches to understanding gang involvement and involvement in violence, with methodologies often guided by the limitations of available data. For the purpose of this study, the data lends itself to the developmental risk framework, looking at isolated incidents of trauma rather than allowing for an understanding of the cumulative risk of stressful life events.

Methodology

For the purpose of this research, *Trauma* will be defined as a victim or witness to a crime before the age of 12. This is the key independent variable of the study and will be tested in multiple models. For the first version of the model, a general understanding of *Trauma* will be used where the variable is a dummy variable equal to one if the individual was reported as a victim or witness in the police dataset before the age of 12, and zero if they were not. Another model is used to explore the effect of multiple traumas, where the dependent variable includes categories of trauma with a base group of individuals that have no recorded incidents of childhood trauma. This allows us to understand if an individual

who has experienced trauma more than once is more likely to be gang involved, arrested, or violent. A final model is used to explore differences in the effects of traumatic incidents based on whether the individual experienced trauma as a witness or victim. For this purpose trauma is conceived as a categorical variable using four groups. The first group experienced trauma as a victim before the age of twelve, the second group experienced trauma as a witness before the age of twelve, and the third group experienced trauma as both a victim and a witness before the age of twelve. Individuals who have not experienced childhood trauma are the base group.

Other variables which will be used in each of the models are the control variables. While the literature suggests the use of more control variables than those available in the Worcester Police Dataset, the controls that will be implemented in the model are race, gender, and age. Gender will be restricted to males. Race will be implemented as a control using the following categories of race: Black; Hispanic; Other Race, Race Missing; and White. White will be used as the control category and excluded from the models. While socioeconomic status, mental health, family structure, and neighborhood have also been seen as important factors in studying delinquency and gang involvement they will not be included in the model as they are not available using the Worcester Police Dataset (Eitle et al., 2004).

This study seeks to understand the effect of trauma on gang involvement, criminal activity, and arrests, and will use three regression models to do so, one for each of the key dependent variables. The model for gang involvement will use the variable *Gang* as a

bivariate dependent variable equal to one if the individual is reported as gang affiliated in a police report and zero if they are not. Each of the models will use a mixture of factors in addition to the independent variable of interest, Trauma. These variables will include demographic information as control variables or number of incidents recorded in the Worcester Police Dataset for the individual. This is shown by the probit model below:

Gang Involvement
Pr(Gang = 1) = Φ (Trauma, Race, Age)

To compare the magnitude of the effect of trauma on the different dependent variables we will use dprobit modeling. Dprobit displays the estimated marginal effect at the sample means allowing the marginal effects of the independent variables across the models to be compared.

The second bivariate probit model, which will also be run using dprobit, will look at the effect of trauma on criminal activity. The binary dependent variable in this model, *Arrest*, will be equal to one if the individual has an incident recorded as an arrest in the Worcester Police Dataset, and zero if they do not. This probit model will also consider the same independent variables as the model for gang involvement, with the possibility for modeling trauma in multiple ways. The model is shown below:

Criminal Activity
Pr(Arrest = 1) = Φ (Trauma, Race, Age)

The final categorical variable of interest is violence. To understand whether trauma increases the risk for involvement in violence in any role, whether as a perpetrator, a witness, or a victim later in life both a dprobit and tobit model will be explored. The

dprobit model will use the binary dependent variable, *Ever Violent* equal to one if the individual has any incident classified as violent later in life in the database and zero if it was not. The model is shown below:

Violence
Pr(Ever Violent = 1) = Φ (Trauma, Race, Age)

This model will also be used to understand whether incidents of trauma effect the risk of perpetrating violence later in life. This will be classified using a dependent variable *Violent Arrest*, equal to one if an individual has been arrested for a violent incident.

It is also important to understand whether trauma increases the likelihood of increased incidents of violence later in life, rather than simply an increased risk of violence. This question is more useful in illuminating the existence of a chronic cycle of violence. The number of violent incidents later in life will also be analyzed as a categorical dependent variable using a tobit model. The dependent variable, *Violent Incidents* will be a categorical variable from 0-20 representing the number of times the individual has been identified as violent in the Worcester Police Dataset. The dependent variable is nonnegative with an upper limit of 20 as this is the highest number of recorded violent incidents for a single individual in the sample. Using the variable described above, the tobit model will be as follows:

Tobit Model:

$$\textbf{Violent Incidents}^* = x\beta + u,\ u|x \sim \text{Normal}(0,\sigma 2) \qquad \text{Where } y = \max(0,20)$$

$$(\beta = \beta_1 \text{ Trauma} + \beta_2 \text{ Demographics})$$

This model also controls for available demographics and will inform whether trauma increases the risk of multiple arrests.

Data

The Worcester Police dataset will be used in this research. The database includes 25,375 individuals with a total of 98,914 incidents. Each individual in the dataset has a unique identifier, which allows the tracking of the individual across incidents. The individuals in the dataset are all male, and range in age from 0-27. The mean age of the individuals is 22 and the median age is 23. Of the males in the database, 46% are missing information on race, 28% are White, 15% are Hispanic, 8% are Black, 2% are Asian, and less than 1% are Indian, Middle Eastern, or Other.

Each individual is counted only once in the dataset, however, an individual may have multiple incidents and so the individual may have multiple roles within the system. The roles of interest are victim, witness, and arrest. Of the individuals in the dataset, 6,790 were ever arrested, or 26.86%, and 11,083 were ever a victim, or 44%.

It is important to understand that if the individual was involved in multiple incidents one or more of the incidents may have been a violent incident, while another may not be violent, and that the individual's role in these incidents may be different and can include witness, victim, and arrest. Therefore, a dummy variable was created for involvement/ exposure to violence, *Ever Violent*, meaning the individual was involved in at least one incident of violence, regardless of role. Overall, 8,113 individuals, or 32% of the sample were involved in at least one violent incident. Of the 8,113 individuals

recorded as violent, only 2,493 were actually arrested, or 9.82% of the individuals in the dataset perpetrated violence. *Violent Arrests* is a dummy variable equal to one if an individual has been arrested at least once for a violent incident, and zero if they have not. These variables allow us to examine the effects of childhood trauma on both the cycle of violence, or being exposed to violence again in any form, and the perpetration of violence.

The largest portion of individuals in the dataset are involved in just one incident, 41%, followed by individuals involved in two incidents, 22%; however, over 20% of the individuals are involved in five or more incidents with the maximum number of incidents for one individual exceeding 100. The mean age of first incident is fourteen-years-old and the median age of first incident is sixteen. Within the dataset 480 individuals are reported as being in a gang, or 1.89% of the sample; however, 76.5% of gang identified individuals in the sample were arrested three or more times. Gang involvement is determined by the Worcester Police Department according to a 10-point system, identification as a gang-involved individual is more subjective. As such, it is possible that individuals are gang involved earlier then records indicate, or that gang involved individuals have not been identified as such. This is a conservative estimate.

The main independent variable of interest in this study is childhood trauma. An individual is defined as having experienced childhood trauma if they have at least one recorded incident before the age of twelve in the dataset where their role is classified as a witness or a victim. In the dataset, 4,940 individuals, or 19.47% experienced at least one police encounter before age 12, what we refer to as an incident of childhood trauma. While

the majority of the individuals that experienced childhood trauma only had 1 recorded incident, 9.97% of the individuals in the dataset, 6.15% of the individuals had two recorded incidents of childhood trauma and 3.35% had three or more incidents of childhood trauma, with the highest number of recorded incidents being 27. To understand the effect of one incident of childhood trauma versus more than one incident childhood trauma is broken into a categorical variable, where *One Trauma* represents individuals with one recorded incident of childhood trauma, *Two Traumas* represents individuals with two recorded incidents of childhood trauma, and *Three plus Traumas* represents individuals with three or more incidents of childhood trauma. In this case, individuals that do not have recorded incidents of childhood trauma in the Worcester Policer Dataset are used as the base group.

The data is limited to police incidents occurring within the jurisdiction of the Worcester Police Department, therefore an individual that may have experienced trauma, such as domestic abuse, will only be considered a victim if such police incident was recorded in Worcester. This means that incidents of either victimization or arrest in areas outside of Worcester are unknown to the data and cannot be factored into the regression analysis. This is a possible source of error which will need to be considered in the analysis.

Results

The results of this paper reveal the negative impact of trauma and show a correlation between incidents of trauma and gang involvement, violence, and later arrests.

The results also reveal racial correlations where nonwhite individuals are more likely to be gang involved, arrested, and violent in incidents recorded in the Worcester Police Dataset

Gang Involvement

In all estimated models for gang involvement incidents of childhood trauma, whether reported as a dummy variable or a categorical variable has a positive and highly statistically significant impact on gang involvement. Gang involvement, or whether an individual has ever been recorded as gang involved in the Worcester Police Dataset is examined in the following dprobit regressions with the binary dependent variable *Gang.* The dprobit model is used rather than the probit model as the dF/dx effects are the marginal effects for an average individual. Therefore, the coefficients are measured in units of probability that an individual, at the mean of the sample, is gang involved if the independent dummy variable goes from 0 to 1. This allows for a comparison of the coefficients across models.

The model representing childhood trauma as a dummy variable equal to one if an individual has any incident of childhood trauma and zero if they do not is shown in column 1 of table 3 (page 26). The estimation shows that an individual that has experienced any childhood trauma is 1.6% more likely to be gang involved than an individual who has experienced no childhood traumas, statistically significant at the 1% level. Table 4 (page 27) shows that when trauma is broken down into a categorical variable to understand whether chronic trauma has a greater negative effect on the key dependent variables one can see that a greater number of childhood traumas increases the probability of being gang

involved. While one or two incidents of childhood trauma are insignificant, individuals with three or more traumas are 4.15% more likely to be gang involved, significant at the 1% level.

Table 5 (page 28) shows the difference in effect of experiencing childhood trauma as a victim or a witness on gang involvement. An individual who has only experienced a form of childhood trauma as a victim is 1.08% more likely to be gang involved than an individual who has experienced no childhood trauma. While the coefficient on witness it is positive and insignificant. However, an individual who has experienced trauma as both a victim and a witness is 5.34% more likely to be gang involved than an individual who has not experienced childhood trauma, statistically significant at the 1% level.

Criminal Activity

The estimated models for criminal activity do not show the hypothesized positive correlation for childhood trauma and arrest when childhood trauma is represented by a dummy variable. Again, the dprobit model is used rather than the probit model as the dF/dx effects are the marginal effects for an average individual. Therefore, the coefficients are measured in units of probability that an individual, at the mean of the sample, has been arrested if the independent dummy variable goes from 0 to 1. This allows for a comparison of the coefficients across models. Table 3 (page 26) column 2 shows a negative and statistically significant relationship between the variable *Any Trauma* and *Ever Arrested*. This means that if an individual has experienced any sort of childhood trauma, and therefore the dummy variable *Any Trauma* is turned on, they are 1.5% less likely to have been arrested ($p<0.01$). However, when

trauma is represented by a categorical variable for the number of traumas recorded in the dataset, shown in table 4 (page 27) the effect of one or two traumas remains negative and statistically significant but having three or more recorded childhood traumas increases the probability of being arrested by 8.4%, a drastic shift from the -6% correlation with only one trauma, both statistically significant at the 1% level. A discussion of possible explanations of this phenomena will follow in the conclusions section.

Table 5 (page 28) makes the distinction for the type of trauma, victim or witness. Column two of table five reveals a positive, statistical significant relationship between having experienced both witness and victim-based trauma and arrest ($p<0.01$). If an individual has recoded incidents of both victimization and witness roles before the age of twelve they are 15.5% more likely to be arrested later in life than an individual who has experienced neither. Table 5 column two also reveals a negative correlation between victim-based trauma and arrests (-3.7%) and between witness-based trauma and arrests (-4.9%), statistically significant at the 1% level. Explanations for this phenomena will be explored in the conclusions section.

Violence

In the estimated models for the effect of childhood trauma on violence, trauma has a positive and highly statistically significant impact on violence. Violence, or the likelihood that an individual will be involved in a violent incident in any role, is examined in the following dprobit regressions with the binary dependent variable *Ever Violent.* Again, the dprobit model is used rather than the probit model as the dF/dx effects are the

marginal effects for an average individual. Therefore, the coefficients are measured in units of probability that an individual, at the mean of the sample, will be involved with, exposed to, perpetrate, or witness violence if the independent dummy variable goes from 0 to 1. This allows for a comparison of the coefficients across models.

The model representing childhood trauma as a dummy variable equal to one if an individual has any incident of childhood trauma and zero if they do not is shown in table 3 (page 26) column 3. The estimation shows that an individual that has experienced any childhood trauma is 20.9% more likely to be exposed to violence later in life than an individual who has experienced no childhood traumas, statistically significant at the 1% level. The likelihood that this individual will be the perpetrator of violence is shown in table 3 (page 26) column 4. An individual who experiences any childhood trauma is 2.58% more likely to perpetrate violence later in life than an individual who has not experienced childhood trauma, statistically significant at the 1% level.

Table 4 (page 27) columns 3 and 4 shows the estimations when trauma is broken down into categorical variables, allowing for a sense of whether chronic trauma has a larger effect on the probability of exposure to violence and more specifically, perpetration of violence. This estimation shows that just one incident of recorded trauma has a negative correlation with being involved in violence later in life ($p<0.05$). However, as the number of traumas increases, so does the probability of being involved in violence, where two traumas increases the probability of by 21.2% and three or more traumas increases the probability of being involved in violence by 49.2%, both statistically significant at the 1% level. More specifically, in table 4 column 4 we also see that three or more traumas is not

only correlated with late exposure or involvement in a violent incident, but also increases the probability that the individual will perpetrate violence by 8%, statistically significant at the 1% level.

Table 5 (page 28) column 3 shows the relationship between different traumatic experiences and involvement in violent incidents, in any role. An individual who has experienced childhood trauma as a victim before the age of twelve is 13.5% more likely to be involved in a violent incident later in life in any role than an individual who has experienced no trauma, statistically significant at the 1% level. An individual who has experienced childhood trauma in the role of victim is 35.3% more likely to be involved in a violent incident later in life, statistically significant at the 1% level. And finally, an individual who has experienced trauma as both a victim and witness is 59% more likely to be involved in a violent incident later in life than an individual who did not experience any trauma, statistically significant at the 1% level.

Table 5 (page 28) column 4 shows the relationship between different traumatic experiences and the perpetration of violence. An individual who has experienced childhood trauma as a victim is 1% more likely to perpetrate violence later in life, statistically significant at the 1% level. An individual who experiences childhood trauma as both a witness and victim is 15.6% more likely to perpetrate violence later in life, statistically significant at the 1% level.

Table 6 (page 29) shows the relationship between trauma and the number of incidents of violence later in life. The dependent variable used in this tobit regression, *Violent Incidents,* is a non-negative variable ranging from 0-20 representing the number of

violent incidents. In column two we see that any incident of childhood trauma increases an individual's likelihood of perpetrating violence, this supports the findings from the probit model shown in table 3 (page 26). However, the tobit model relates childhood trauma with the likelihood of multiple incidents of violence, rather than the risk of a single incident of violence later in life. An individual who is more likely to engage in multiple incidents of violence further perpetuates the cycle of violence. In table 6 (page 29) column 2 shows that any incidence of childhood trauma increases the number of violent incidents later in like by .8 for the average individual, statistically significant at the 1% level. Column 1 of table 6 shows the relationship between witness and victim-based trauma and incidents of violence. Column two reveals that the number of violent incidents later in life is increased by a larger magnitude if an individual has solely experienced witness-based trauma, an increase in violent incidents of .531 ($p<0.01$) than if an individual has solely experienced victim-based trauma, an increase in violent incidents of .458 ($p<0.01$). The number of violent incidents is not surprisingly increased by the largest magnitude for individuals who have experienced both witness and victim-based childhood trauma. This group has 3.078 more incidents of violence than the base group, individuals with no trauma, statistically significant at the 1% level.

Discussions and Conclusions

Understanding trends in criminal activity and violence is crucial to preventing cycles of violence responsible for the premature deaths of too many of America's boys and men of color. Examining the effects of childhood trauma on criminal activity, involvement

in violence, perpetration of violence, and gang involvement later in life for men in the Worcester Police Database is crucial to crafting an intervention that may break this cycle of violence.

When childhood trauma is represented as a dummy variable, zero if an individual has not experienced childhood trauma, one if they have, any incident of childhood trauma increases the probability of being gang involved, of being exposed to violence again in any role, and of perpetrating violence, all statistically significant at the 1% level.

When the type of trauma is distinguished between victim-and witness-based trauma, shown in table 5 (page 28), we see that victim-based trauma has a negative correlation with being involved in violence late in life of -2% ($p<0.01$), but a small positive correlation with perpetrating violence of 1.01% ($p<0.01$). We suspect that these differences may be related to existing victim-based interventions. However, witness-based trauma increases the probability of being involved in violence later in life by 21% ($p<0.01$). We propose that the differing effect of victim-or witness-based trauma may be explained in that individuals who experience trauma as a victim have a greater likelihood of receiving an intervention, for example DCF intervention or connection to services, than those who experience trauma as a witness. Under the current system in Worcester, children under twelve who are witnesses to crime do not receive an intervention. The notion that childhood trauma victims may receive some level of intervention is also supported by the tobit model in table 6. This model shows that while a victim of childhood trauma will likely be involved in .458 more violent incidents, in any role, than an individual who has

not experienced trauma, an individual with witness-based childhood trauma will be involved in .531 more violent incidents, both statistically significant at the 1% level. Individuals who experience witness-based traumas are therefore predicted to be involved in more violent incidents than those who experience victim-based trauma. However, individuals who experience victim-based trauma have a positive correlation with perpetrating violence ($p<0.01$), shown in table 5.

The individuals with the highest risk of involvement in violence later in life in any role, the highest likelihood to perpetrate violence, and highest number of predicted violent incidents are those individuals who have experienced both witness and victim-based trauma. This group is 49.2% more likely to have a violent incident later in life than individuals who have experienced no trauma and are predicted to have 3.078 more incidents involving violence recorded, both statistically significant at the 1% level. In addition, this group is 15.6% more likely to perpetrate or commit violence later in life, statistically significant at the 1% level. These findings reveal the need for an intervention that would effectively mitigate the negative effects of witness-based childhood trauma in addition to victim-based.

This study shows that childhood trauma perpetuates cycles of violence in Worcester. Childhood trauma increases both the probability that an individual will be exposed to violence, whether as a victim, witness, or perpetrator, and the probability that they will commit violence (table 3, column 3 and 4), both statistically significant at the 1% level. This shows the critical need for crisis intervention for youth under the age of 12 who

experience police contact. This may help reduce both the probability that an individual will be exposed to violence in general, and the probability that they will perpetrate violence.

While this dataset is useful in predicting patterns in the cycle of violence in Worcester there are many factors that cannot be controlled for in this sample. These factors include variables that were controlled for in other studies of the cycle of violence and gang involvement and include socioeconomic status, family structure, neighborhood, school performance, as well as others. In addition, this sample is restricted to individuals in the Worcester Police Dataset, making it impossible to track the individual's history of both childhood trauma, gang involvement, and arrests later in life if these incidents occurred outside of the Worcester police jurisdiction.

This study shows a positive and highly statistically significant correlation between childhood trauma and gang involvement as well as involvement in violence, perpetration of violence, and the number of incidents of violence. Even within the limitations of an imperfect dataset, this correlation can be used as evidence to support intervention efforts after childhood trauma occurs.

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Appendix: Tables

Table 1: Factors influencing Gang Involvement, Criminal Activity, and Violence

Influencing Factor	Variable	Predicted Sign
Childhood Trauma	Categorical Variables: One Trauma, Two Traumas, and Three Plus Traumas, using a base group of no incidents of childhood trauma	+
Race / Ethnic Group	Dummy variables for Black, Hispanic, Missing Race, and Other Race (White= base group)	+/-
Age	Categorical Variable, 10-15, 15-18, 18-22, 22-27 with a base group of 0-10	+

Table 2: Summary Statistics

Worcester Police Dataset (N=25,375)	
Breakdown by Gender	
	Percent
Male	100
Female	0
Breakdown by Current Age	
0-10 Years-old	7.42
10-15 Years-old	8.6
15-18 Years-old	8.8
18-22 Years-old	21.34
22-27 Years-old	53.82
Breakdown by Grade	
9^{th} Grade	26.57
10^{th} Grade	26.49
11^{th} Grade	23.39
12^{th} Grade	23.55
Breakdown by Race	
Black or African American	7.9
Hispanic/ Latino	15.33
White	28.15
Other Race	2.75
Race Missing	45.87
Breakdown by Childhood Trauma	
No Childhood Trauma	80.53
One Trauma	9.97
Two Traumas	6.15
Three Plus Traumas	3.35
Dependent Variables	
Gang	1.89
Ever Arrested	26.76
One Arrest	8.15
Two Plus Arrests	18.61
Ever Violent	32.04
Violent Arrest	9.82

Table 3: The Effect of any Childhood Trauma on Gang Involvement, Criminal Activity, and Violence

VARIABLES	Gang	Ever Arrested	Ever Violent	Violent Arrest
	(1)	(2)	(3)	(4)
Any Trauma	0.0158***	-0.0151***	0.209***	0.0258***
	(0.00241)	(0.00413)	(0.00836)	(0.00285)
Age 11 to 15	0.00827	0.960***	-0.0508***	0.990***
	(0.0103)	(0.00120)	(0.0140)	(0.000306)
Age 16 to 18	0.0660***	0.967***	0.0182	0.994***
	(0.0245)	(0.00132)	(0.0150)	(0.000670)
Age 19 to 22	0.0766***	0.996***	0.0352***	0.774***
	(0.0218)	(0.000309)	(0.0132)	(0.00721)
Age 23 to 27	0.0308***	0.946***	0.0263**	
	(0.00681)	(0.00258)	(0.0122)	
Observations	25,375	25,375	25,375	

*** p<0.01, ** p<0.05, * p<0.1

Source: Results of probit estimations on Worcester Police Dataset (2015).

Notes: Marginal effects are shown instead of confidents. Standard errors in parentheses. *Gang*=1 if an individual is recorded as gang involved in the Worcester Police Dataset, 0 if they are not. *Ever Arrested*=1 if an individual has a recorded arrest in the Worcester Police Dataset, 0 if they do not. *Ever Violent*=1 if an individual has at least once incident of violence recorded in the Worcester Police Dataset, 0 if they do not. *Violent Arrest*=1 if an individual has been arrested for a violent incident. *Any Trauma*=1 if an individual has any recorded incident of childhood trauma (victim or witness before the age of 12), 0 if they do not. Race is controlled for in the model. The base group for Age is 0-10. The results are restricted to males only.

Table 4: The Effect of Chronic Childhood Trauma on Gang Involvement, Criminal Activity, and Violence

VARIABLES	Gang	Ever Arrested	Ever Violent	Violent Arrest
	(1)	(2)	(3)	(4)
One Trauma	-0.00331	-0.0665***	-0.0230**	-0.0107***
	(0.00239)	(0.00353)	(0.0113)	(0.00241)
Two Traumas	0.00559	-0.0536***	0.212***	0.000355
	(0.00360)	(0.00416)	(0.0144)	(0.00341)
Three Plus Traumas	0.0415***	0.0849***	0.492***	0.0803***
	(0.00556)	(0.00912)	(0.0114)	(0.00682)
Age 11 to 15	0.00570	0.968***	-0.0637***	0.993***
	(0.00924)	(0.00104)	(0.0140)	(0.000531)
Age 16 to 18	0.0525**	0.974***	-0.0182	0.997***
	(0.0214)	(0.00113)	(0.0147)	(0.000521)
Age 19 to 22	0.0602***	0.997***	-0.00910	0.807***
	(0.0189)	(0.000203)	(0.0131)	(0.00856)
Age 23 to 27	0.0243***	0.959***	-0.0220*	-0.0107***
	(0.00626)	(0.00214)	(0.0125)	(0.00241)
				0.000355
Observations	25,375	25,375	25,375	25,362

*** p<0.01, ** p<0.05, * p<0.1

Source: Results of probit estimations on Worcester Police Dataset (2015).

Notes: Marginal effects are shown instead of confidents. Standard errors in parentheses. *Gang*=1 if an individual is recorded as gang involved in the Worcester Police Dataset, 0 if they are not. *Ever Arrested*=1 if an individual has a recorded arrest in the Worcester Police Dataset, 0 if they do not. *Ever Violent*=1 if an individual has at least once incident of violence recorded in the Worcester Police Dataset, 0 if they do not. *Violent Arrest*=1 if an individual has been arrested for a violent incident. *One Trauma*=1 if an individual has a recorded incident of childhood trauma (victim or witness before the age of 12), 0 if they do not. *Two Traumas*=1 if an individual has two recorded incidents of childhood trauma, 0 if they do not. *Three Plus Traumas*=1 if an individual has 3 or more recorded incidents of childhood trauma, 0 if they do not. The base group is individuals who have no recorded incidents of childhood trauma. Race is controlled for in the model. The base group for Age is 0-10. The results are restricted to males only.

Table 5: Distinguishing Between Victim and Witness Trauma on Gang Involvement, Criminal Activity, and Violence

VARIABLES	Gang	Ever Arrested	Ever Violent	Violent Arrest
	(1)	(2)	(3)	(4)
Victim	-0.00331	-0.0665***	-0.0230**	0.0101***
	(0.00239)	(0.00353)	(0.0113)	(0.00280)
Witness	0.00559	-0.0536***	0.212***	-0.00179
	(0.00360)	(0.00416)	(0.0144)	(0.00666)
Victim and Witness	0.0415***	0.0849***	0.492***	0.156***
	(0.00556)	(0.00912)	(0.0114)	(0.0149)
Age 11 to 15	0.00570	0.968***	-0.0637***	0.988***
	(0.00924)	(0.00104)	(0.0140)	(0.000265)
Age 16 to 18	0.0525**	0.974***	-0.0182	0.988***
	(0.0214)	(0.00113)	(0.0147)	(0.00118)
Age 19 to 22	0.0602***	0.997***	-0.00910	0.729***
	(0.0189)	(0.000203)	(0.0131)	(0.00804)
Age 23 to 27	0.0243***	0.959***	-0.0220*	
	(0.00626)	(0.00214)	(0.0125)	
Observations	25,375	25,375	25,375	25,362

*** p<0.01, ** p<0.05, * p<0.1

Source: Results of probit estimations on Worcester Police Dataset (2015).

Notes: Marginal effects are shown instead of confidents. Standard errors in parentheses. *Gang*=1 if an individual is recorded as gang involved in the Worcester Police Dataset, 0 if they are not. *Ever Arrested*=1 if an individual has a recorded arrest in the Worcester Police Dataset, 0 if they do not. *Ever Violent*=1 if an individual has at least once incident of violence recorded in the Worcester Police Dataset, 0 if they do not. *Victim*=1 if an individual has a recorded incident of victimization before age twelve, 0 if they do not. *Witness*=1 if an individual has a recorded incident as a witness before age twelve, 0 if they do not. *Victim and Witness*=1 if an individual has recorded incidents as both a victim and a witness before age twelve, 0 if they do not. The base group is individuals who have no recorded incidents of childhood trauma. Race is controlled for in the model. The base group for Age is 0-10. The results are restricted to males only.

Table 6: Childhood Trauma and Violent Incidents

VARIABLES	Violent Incidents	Violent Incidents
	(1)	(2)
Victim	0.458***	
	(0.0238)	
Witness	0.531***	
	(0.0660)	
Victim and Witness	3.078***	
	(0.0492)	
Any Trauma		0.800***
		(0.0222)
Age 11 to 15	-0.0392	-0.00663
	(0.0407)	(0.0422)
Age 16 to 18	0.124***	0.227***
	(0.0407)	(0.0422)
Age 19 to 22	0.254***	0.407***
	(0.0357)	(0.0369)
Age 23 to 27	0.343***	0.512***
	(0.0338)	(0.0347)
Constant	0.0437	-0.108***
	(0.0317)	(0.0326)
σ	1.291***	1.342***
	(0.00457)	(0.00407)
Observations	25,375	25,375

*** p<0.01, ** p<0.05, * p<0.1

Source: Results of tobit estimations on Worcester Police Dataset (2015).

Notes: Estimation using tobit model where the dependent variable, *Violent Incidents* is constrained from 0-20, representing the number of violent incidents. Standard errors in parentheses. *Victim*=1 if an individual has a recorded incident of victimization before age twelve, 0 if they do not. *Witness*=1 if an individual has a recorded incident as a witness before age twelve, 0 if they do not. *Victim and Witness*=1 if an individual has recorded incidents as both a victim and a witness before age twelve, 0 if they do not. Race is controlled for in the model. The base group for Age is 0-10. Restricted to males only.