

ABSTRACT

EXPLORING THE RELATIONSHIP BETWEEN OXYTOCIN, RISK-TAKING, AND CHILDHOOD MALTREATMENT

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Maltreatment in childhood can lead to a vast number of negative outcomes for survivors. Some of these negative outcomes include engagement in risky and impulsive behaviors that can lead to imprisonment, health problems, or early death. A link between oxytocin (OT) and impulsivity has been identified, and administration of OT has shown to decrease impulsive behavior or risk-taking during various tasks. Although there is a link between OT and risk-taking, as well as between childhood maltreatment and OT, there are no studies to date that have analyzed the effect of OT on the relationship between childhood maltreatment and risk-taking. The present study employs simple mediation analyses to explore this relationship among a sample of young adults who have experienced childhood maltreatment ($N=97$) from two very different backgrounds; 54 of which were active probationers and 47 college students in an introductory psychology course. OT samples were obtained through analyses of donated saliva samples, and risk-taking was measured through participant performance on a computerized card game task.

This study proposed four core hypotheses: (1) Individuals who reported higher overall levels of childhood maltreatment would have lower levels of salivary OT and there would be an indirect effect of salivary OT levels on risk-taking; (2) Individuals who experienced more forms

of maltreatment would have lower salivary OT and there would be an indirect effect of salivary OT levels on risk-taking; (3) Individuals who experienced more emotional maltreatment would have lower salivary OT and OT levels would have an indirect effect on the relationship between emotional maltreatment and risk-taking; and (4) Individuals who have experienced more emotional abuse would have lower OT levels and OT levels would have an indirect effect on the relationship between emotional abuse and risk-taking. Contrary to these hypotheses, data analyses demonstrated that there were no indirect effects or direct effects of salivary OT levels on risk-taking for any form of neglect or abuse; however, the relationships between OT and overall maltreatment, overall emotional maltreatment (abuse and neglect), and emotional abuse that have been identified in the literature were confirmed.

Keywords: oxytocin, risk-taking, childhood maltreatment, abuse, neglect

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AND CHILDHOOD MALTREATMENT

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CHAPTER I: LITERATURE REVIEW

Purpose

Childhood maltreatment has been linked negative consequences for survivors that are detrimental and can be life-long in nature. Some of the negative consequences that have been associated with childhood maltreatment include suicidal behaviors (Dube et al., 2001), non-suicidal self-injury (NSSI; Swannell et al., 2012), poor mental health (Kaplow & Widom, 2007; Edwards, Holden, Felitti, & Anda, 2003), criminal behavior (Topitzes, Merksy, & Reynolds, 2011) substance abuse (Lo & Cheng, 2007), and physical health problems (Springer, Sheridan, Kuo, & Carnes, 2007). Consequences such as suicidal behaviors and substance abuse can lead to premature death. The previously mentioned adverse outcomes along with others, such as increased aggression and engagement in criminal behavior, can lead to incarceration, job loss, loss of relationships, and financial distress. These ramifications suffered by survivors bleed into the lives of the people around them and impact our society as a whole. The long-term and far-reaching impact of childhood maltreatment makes our understanding of the aftermath vitally important to be best able to serve these individuals and to build a future of hope together.

Many of the mentioned negative outcomes experienced by survivors of childhood maltreatment are external behaviors or consequences that can readily be observed or documented, while the underlying causes of these outcomes have been more difficult to detect or understand. More recent developments in science have made it possible to explore the neurobiological impact of adverse childhood experiences, which may explain in part the pathways that lead to negative outcomes. Although recent studies have identified a relationship between childhood maltreatment and OT levels (Heim et al., 2009; Strathearn, 2011), as well as OT and impulsive or risk-taking behaviors (Dougherty, Bjork, Huckabee, Moeller, & Swann,

1999; White et al., 1994; Patel et al., 2015), no studies to date have explored OT as a mediator in the relationship between childhood maltreatment and risk-taking behaviors.

The aim of this thesis is to explore the possibility of OT as a mediator within the relationship between a history of childhood maltreatment and risk-taking behaviors, as well as how this effect is impacted by the number of different forms of maltreatment or differential experiences of maltreatment experienced by survivors. This thesis will expand upon the literature that has linked childhood maltreatment to differences in OT levels by using a sample of both men and women. Additionally, this study will broaden our understanding of the relationship between OT and risk-taking by exploring how this relationship is impacted by a history of childhood maltreatment. Exploring these relationships is important because although we know that experiences of maltreatment in childhood lead to negative outcomes for survivors, we do not entirely understand the *why* of this relationship.

Maltreatment

The Child Abuse Prevention and Treatment Act, signed by President Nixon in 1974, represented a shift in the way that the U.S. Federal Government approached child abuse and neglect (Child Welfare Information Gateway, 2017). Although parents had historically been allowed to treat their children however they saw fit without legal consequences, the story of Mary Ellen Wilson brought the horrors of childhood maltreatment to light within the public eye; it has been described as a catalyst in the events that led to the federal protection of children throughout the U.S. (National Child Abuse and Neglect Training and Publications Project [NCANTP], 2014). Mary Ellen Wilson was bruised, scarred, and significantly smaller than other children her age. She had no bed, no toys, and was not allowed to have contact with other

children. The prosecution of her guardians in 1874 led to the first court conviction of a parent for child abuse in the U.S., setting the stage for other convictions to follow (Jalongo, 2006).

Mary Ellen Wilson was only one of countless children who have been abused and neglected by their caregivers. In 2017 alone, 683,000 children were identified as victims of childhood maltreatment; 74.9% of these children were victims of neglect, 18.3% of these children were physically abused, and 8.6% were sexually abused. Additionally, approximately 1,720 of these victims suffered death, with approximately 71.8% of victims being under the age of three years. A disturbing trend has also been identified through recent statistics; child fatalities related to maltreatment increased by 11% between 2013 and 2017, and child abuse and neglect increased by 2.8% between 2013 and 2017 (U.S. Department of Health and Human Services, 2017). It is possible that the increase we have seen in overall maltreatment could be partially be related to changes in reporting laws over time (Child Welfare Information Gateway, 2016). For example, as recently as April of 2019, Maryland enacted a bill which implemented criminal penalties for mandated reporters who fail to fulfill their obligation to report child abuse and neglect (H. 787, 2019). Although these laws may have increased the number of abuse and neglect cases that are detected, it is unlikely that changes in these laws has increased the rate at which child deaths related to maltreatment are discovered.

Throughout the literature, several forms of childhood maltreatment are defined; however, these definitions are often inconsistent and can vary drastically from study to study. This problem was described as a major barrier to cohesive research on childhood maltreatment in a report published by the National Research Council (1993). Although most of the literature references some variation of five types of maltreatment; the structure, definitions, or terminology can look quite different. For example, in some studies, abuse and neglect are not separated into

different types of maltreatment (i.e. physical abuse/physical neglect, emotional abuse/emotional neglect). Furthermore, Higgins and McCabe (2001) referred to witnessing domestic violence as a form of maltreatment, although Felitti and colleagues (1998) referred to witnessing domestic violence as an adverse childhood experience rather than a form of maltreatment. Another difference that is apparent in the literature is that emotional abuse and neglect are interchangeably referred to as psychological maltreatment (Higgins & McCabe, 2001). Finally, a literature review conducted by Jackson and colleagues (2019) revealed that although most studies primarily focus on *type* of maltreatment experienced, other studies conceptualize maltreatment in terms of severity, frequency, or chronicity. These authors suggested using more complex statistical analyses and discussions of measurement limitations due to the complex nature of maltreatment.

During the initial development of the Childhood Trauma Questionnaire (CTQ), a retrospective measure of experiences of childhood maltreatment, Bernstein and colleagues (1994) identified four different factors or types of abuse by using principle components analysis. The original four types of maltreatment on this measure included abuse (physical and emotional combined), emotional neglect, physical neglect, and sexual abuse (Bernstein et al., 1994). The original CTQ was later updated to separate physical and emotional abuse, resulting in five factors or types of abuse (Bernstein & Fink, 1997). Furthermore, a short-form version of the CTQ (CTQ-SF) was developed which was also designed around a five-factor structure; the CTQ-SF measures the same constructs as the original CTQ but overcomes some of its limitations regarding time required for administration (Bernstein et al., 2003). The present study utilized the CTQ-SF as a measure of maltreatment, and for this reason the five forms defined by Bernstein

and colleagues are the focus of this study. The five forms of maltreatment defined by Bernstein and Fink are presented in Table 1.

Table 1.

Different Forms of Maltreatment (Bernstein & Fink, 1997)

Sexual Abuse	Sexual interactions between a child and someone over the age of 18
Physical Abuse	Assault by an adult on a child which could have or did cause injury.
Emotional abuse:	Interactions between an adult and child in which the adult embarrasses or demeans the child or devalues a child’s sense of worth.
Physical Neglect:	Failure of caretakers to provide basic physical needs of the child.
Emotional Neglect:	Failure of caretakers to respond to emotional and psychological needs of children.

The importance of identifying and defining different types of maltreatment arises from the functional implications for treatment and prevention efforts; different types of maltreatment have a differential impact on survivors regarding emotional, psychological, and physical wellness (Blair et al., 2019; Rodgers et al., 2004; Cohen et al., 2013; Senn & Carey, 2010). Despite the value of clarification of maltreatment history, there are barriers to identifying the individual impact of each form of abuse as well as the overall prevalence. One barrier addressed in the literature, is that different types of childhood maltreatment are often intertwined with one-another. For example, sexual abuse can often include components of physical abuse, such as injury and violence; and physical abuse can include components of emotional abuse, such as shaming and name-calling. For this reason, it can be difficult to parse out what forms of childhood maltreatment are specifically linked to different outcomes (Tricket & McBride-Chang, 1995). Another problem in identifying the impact of varying types of abuse is that most measures

of the impact of childhood maltreatment are retrospective in nature. This is concerning because some survivors of abuse are more likely to report forgetting events and details of maltreatment. This is especially prevalent among individuals who have experienced sexual abuse in certain circumstances; males, individuals who have spent more time in therapy, individuals who have reported having more nightmares or flashbacks, and individuals who have experienced more severe abuse are more likely to endorse forgetting maltreatment experiences than survivors who do not match one of these characteristics (Ghetti et al., 2006).

In addition to the barriers surrounding classification of maltreatment experiences, there are barriers to disclosure of childhood maltreatment that are unique to different populations; the difficulty of disclosure is dependent upon many factors, including gender, culture, religious affiliation, and social expectations (Lev-Wiesel & First, 2018; Fontes & Plummer, 2010). For example, a large percentage of sexual abuse victims included in research are female, although many males also experience sexual abuse (Trickett & McBride-Chang, 1995). This problem could be partly due to social norms and expectations for men and boys which could make disclosure more difficult. This is problematic because aside from disclosure being an important part of recovery from trauma, the true prevalence rates of sexual abuse are not known. This could mean that a subset of sexual abuse survivors has been excluded from research over time (Sorsoli, Kia-Keating, & Grossman, 2008).

Regarding the developmental impact of each form of childhood maltreatment, a literature review conducted by Trickett and McBride-Chang (1995) compiled data from several different scholarly articles and summarized the negative effects of childhood maltreatment that could impact development. The authors noted that different types of maltreatment appear to result in different repercussions depending upon two factors: what developmental stage a child was in at

the time of abuse, and whether the child experienced only one form of abuse vs. multiple forms of abuse. Although these findings are somewhat unclear due to the overlap of maltreatment experiences explained previously, it appears that experiencing multiple forms of maltreatment is related to individuals experiencing both externalizing (i.e. behavior) and internalizing (i.e. depression, anxiety) difficulties. The authors of this study recommended that future research explore the differential impact of abuse by dividing participants into groups based on whether they experienced one type of abuse or multiple forms of abuse. Additionally, they recommended exploring how different types of abuse impact individuals depending upon their biological sex. A summary of the findings of this literature review is presented in Table 2.

Table 2. Negative Outcomes Related to Child Development: Different Forms of Abuse (Trickett & McBride-Change, 1995).

Sexual Abuse	Physical Abuse	Neglect	Mixed Abuse
Enuresis	Insecure attachment	Problems with peers	Delayed motor development
Somatic Complaints	Conduct problems	Insecure attachment	Low motor competence
E Anxiety	Low empathy	Withdrawal	Insecure attachment
PTSD	Social difficulties	Lack of affect with peers	Less exploring
Depression	Poor Problem-Solving Abilities	Developmental Delays	Peer difficulties
Conduct Problems	Oppositional behaviors	Delayed language	Verbal and physical aggression
Dysregulation of Cortisol	Withdrawal	Very low academic performance	Anger/Hostility
Dissociation	Wariness	Poor school attendance	Low Prosocial Behavior
Learning Problems	Less Prosocial Behaviors	Grade retention	Avoidance of social interaction
Cognitive Delays	Conduct Problems	Learning problems	Poor social problem-solving
Withdrawal from Family and Friends	Low Maturity (Cognitive)	Depression	Low Cog. Assessment scores
Inappropriate sexual acts	Scars	Anxiety	Low learning readiness
Lower IQ scores	Lower heart rate	Conduct problems	More dependency
Lower academic performance	Pessimistic outlook		Less able to follow direction
Suicidal and Self-Injurious Behaviors	Atypical social group		Low maturity (cognitive)
Genital Irregularities	Low peer status and ratings		Low IQ Scores
Elopement	Grade retention		Low self-esteem
Earlier Sexual Activity	Low academic performance		Low self-competence
More Sexual Partners	Low IQ scores		Poor response to peer provocation
	Developmental Disability		PTSD
			Oppositional Defiant Disorder
			Delinquency
			Elopement

In addition to the early negative impact, physical harm, and death caused by childhood abuse and neglect there is an unfavorable emotional and mental impact which can lead to poor lifetime trajectories, poor physical health, antisocial behavior, and life-long mental health difficulties. The landmark study known as the Adverse Childhood Experiences (ACE) study

conducted by Felitti and colleagues (1998), revealed a strong relationship between exposure to adverse childhood experiences and risky behaviors and diseases that lead to early death in adults. This relationship is graded, in that individuals who experience more types of adverse childhood experiences are at greater risk for engaging in risky health behaviors or to be diagnosed with an illness. Adverse childhood experiences that were evaluated were labeled under seven distinct categories including psychological abuse, physical abuse, sexual abuse, substance abuse in the family, mental illness in the family, mother treated violently, and criminal behavior in the household. Individuals who were exposed to adverse experiences under one category had a 65-93% probability of being exposed to another adverse experience category. Additionally, individuals who were exposed to four or more adverse experience categories were up to 12 times more likely to be alcohol or drug dependent, experience depression, or attempt suicide; up to 4 times more likely to smoke, have more than 50 sexual partners, and rate their own health as being poor; and up to 1.6 times more likely to be physically inactive or severely obese than individuals who were exposed to none of the aforementioned adverse experiences. Diseases which were more frequent in individuals who were exposed to adverse childhood experiences included chronic lung disease, heart disease, liver disease, bone fractures, and cancer, among others. In the discussion of this study, the authors proposed that the reason for this increased risk of early death, disease, and risky health behaviors may be a chain initiated by the individual's use of unhealthy behaviors to cope in the moment with these difficult and often traumatic experiences (Felitti et al., 1998).

In support of the ACE Study, Springer, Sheridan, Kuo, and Karnes (2007) found that being physically abused as a child is linked to substantial increases in medical diagnoses and physical symptoms, with increases ranging from 21-22%. Examples of medical diagnoses and

physical symptoms which are higher among survivors of childhood maltreatment include liver disease, asthma, allergies, high blood pressure, heart disease, and ulcers, among many others. Within this population, liver disease is the most common out of the previously mentioned ailments (Springer et al., 2007). Additionally, obesity, frequent headaches, chronic fatigue, stomachaches, and many other health problems were reported more frequently in a sample of women who reported having been maltreated as children as opposed to women who reported no maltreatment. These women were also more likely to be hospitalized for an ailment or surgery, or see themselves as less physically and psychologically healthy than women who reported no abuse (Moeller, Moeller, & Bachmann, 1993).

Mental health is another domain which has shown to be negatively impacted by experiences with abuse in childhood. Individuals with a history of childhood maltreatment are more likely to be diagnosed with depression in their lifetime, and depression is more likely to be recurrent and chronic in nature among this population (Nanni, Uher, & Danese, 2012). Furthermore, individuals who were abused as children are more likely to be diagnosed with Bipolar Disorder (BD) or an anxiety disorder, or abuse alcohol (Lee & Park, 2016). Horwitz, Widom, McLaughlin, and White (2001) reached a similar conclusion when they discovered that men and women who were abused as children were more likely to have symptoms of or be diagnosed with Persistent Depressive Disorder and Antisocial Personality Disorder than adults who reported no history of maltreatment. Additionally, women were more likely to have difficulties with alcohol abuse and dependence than women who were not abused. Stressful life events were also more frequent among the adults who were maltreated as children, and when controlling for life stressors, the direct effects of maltreatment on mental health outcomes became insignificant. This indicates that experiences of childhood maltreatment may impact

individuals in a complex way; maltreatment experiences may create more life stressors which in turn impact mental health in a more profound way (Horwitz et al., 2001).

In addition to the negative outcomes of maltreatment previously mentioned, negative outcomes of abuse are also linked to an increased likelihood of future experiences of abuse, adolescent delinquency, and involvement in the criminal justice system. Women who have experienced abuse as children are more likely to be abused by a domestic partner later in life, which demonstrates that the cycle of abuse and trauma may be passed down to the next generation (Cannon, Bonomi, Anderson, Rivara, & Thompson, 2010). Although many studies have reported that delinquency in adolescence is significant among both males and females (Widom & Maxfield, 1996), other studies have identified this effect only among males (Topitzes et al., 2011). In spite of these contradictory findings, many studies have reported that individuals who were abused as children, both males and females, are more likely to be arrested or convicted for a criminal offense as adults (Horwitz et al., 2001; Topitzes et al., 2011). For example, in a sample of 361 incarcerated juvenile offenders in New South Wales, Australia, 60% reported having been abused or neglected as children (Moore, Gaskin, & Indig, 2013). Similarly, among incarcerated adult males convicted with felony offenses, 58.1% reported having been physically abused, 14.3% reported being sexually abused, and 16% reported being neglected as children (Weeks & Widom, 1998). This pattern has also been identified among incarcerated women; within a sample of 85 incarcerated women, 40% reported being sexually abused as children and 55% reported being physically abused (Zlotnick, 1997). Although individuals engage in antisocial behaviors as a result of a variety of biological, social, and psychological factors (Brennan & Raine, 1997); childhood maltreatment is a predictor of future criminal behavior; this relationship has been found to be strengthened among individuals who have experienced more

forms of maltreatment (Currie & Tekin, 2012). This revelation combined with findings that indicate that oxytocin levels also vary with experiences of maltreatment, have played a role in inspiring the hypotheses for the present study (Heim et al., 2009). Given the great cost that is associated with antisocial and criminal behaviors, it is important to understand how associated traits, such as risk-taking, or biological factors could influence these behaviors (Dhami & Mandel, 2012; Levy et al., 2015).

Oxytocin

Often called the “love hormone”, OT is a neuropeptide found in mammals, which has been linked to many different prosocial and mating behaviors. It is primarily generated in the hypothalamus and operates in the body to assist a variety of functions (Carter et al., 2007). Although OT is most well-known for the role it plays in reproductive behavior such as labor, orgasm, human milk production, and parent-child bonding; more recent research has shown that the function of OT goes much deeper (Magon & Kalra, 2011). Studies conducted within the last 15 years have demonstrated that the administration of OT to human participants is linked to increased trust and generosity towards strangers (Kosfeld, Heinrichs, Zaks, Fischbacher, & Fehr, 2005; Zak, Stanton, & Ahmadi, 2007). Subtle social cues are also more correctly recognized and interpreted by individuals with higher OT levels, explaining in part why it may facilitate social bonding (Domes, Heinrichs, Michel, Berger, & Herpertz, 2007). Additionally, OT plasma levels are higher among individuals who describe themselves as being “in love” (Magon & Kalra, 2011). Finally, in study in which individuals were intranasally administered either OT or a placebo, individuals who had received OT demonstrated a less intense fear response in the amygdala; functional magnetic resonance imaging (fMRI) revealed lower connectivity of the

amygdala to the brainstem when presented with fear-provoking stimuli among these individuals (Kirsch et al., 2005).

The positive social impact imparted by OT is accompanied by many other benefits such as decreases in addictive behaviors toward substances such as food and drugs. Kovács, Sarnyai, and Szabó (1998) found that when rodents who had become addicted to narcotics such as heroin and cocaine were administered OT, they consumed less of the addictive substances and displayed less withdrawal symptoms. Another study demonstrated that mice who lacked the OT gene consumed more sugar water during stressful conditions than mice with the OT gene (Billings, Spero, Vollmer, & Amico, 2006). Among humans, intranasal administrations of OT have been successful in reducing the number of calories consumed by males after a period of fasting (Lawson et al., 2015). Furthermore, intranasal administrations of OT have been successful in reducing impulsive eating among a small sample of obese males (Plessow, Marengi, Perry, & Lawson, 2016).

Positive touch, warmth and odors are all experiences that can trigger a release of OT into the body (Uvnäs-Moberg, 1998). While these types of pleasant experiences can cause OT production, maternal emotional neglect has been associated with lower salivary OT levels (Strathearn, 2011). Similarly, Heim and colleagues (2009) found that women who were exposed to childhood maltreatment had lower CSF OT levels, and that there was an inverse relationship between the number of forms of maltreatment experienced and CSF OT levels. OT levels were lowest among individuals who had experienced three or more forms of maltreatment. This study further identified that emotional abuse, physical abuse, and emotional neglect were the three forms of maltreatment that were significantly related to lower levels of CSF OT, in descending order of significance. Other recent studies that have explored the impact and nature of OT have

revealed compelling findings; these studies revealed that low levels of OT are prevalent among women with Borderline Personality Disorder (BPD) and that among a sample of African-American women in the second trimester of pregnancy, higher levels of OT were related to lower levels of depression (Bertsch, Schmidinger, Neumann, & Herpertz, 2013; Garfield et al., 2015). Low OT levels have also been related to suicidal intent among males who attempted suicide; males with lower CSF OT levels scored higher on the Beck Suicide Intent Scale (SIS; Jokinen et al., 2012).

In addition to the complex influences of OT already mentioned, OT appears to have a unique relationship with the behavioral traits of impulsivity and risk-taking. The link between OT and impulsivity or risk-taking is apparent in several studies. Demirci and colleagues (2016) identified a strong negative relationship between OT levels and levels of impulsivity in a sample of boys between the ages of 8 and 15 who were previously diagnosed with ADHD. In this study, impulsivity was measured using the Barratt Impulsiveness Scale (BIS), which is a commonly used self-report rating scale with strong reliability, as well as convergent and concurrent validity (Stanford et al., 2009). Another interesting way in which OT administration has demonstrated influence over risk-taking behavior, is that male participants who received intranasal administrations of OT exhibited more aversion to risk-taking when completing a virtual risk-taking task; this effect only occurred while participants were in the presence of others (Patel et al., 2015). Furthermore, OT has demonstrated to play a part in aggression, which is often considered to be a risky or impulsive behavior (Lee, Ferris, Van de Kar, & Coccaro, 2009). In addition to this past research that has linked OT to risk taking, recent findings that were published in 2019, revealed that intranasal administration of OT was related to higher net scores and more advantageous deck selections made by participants on a computerized card game task

(Iowa Gambling Task). This finding is important to the present research, because it demonstrates that risk-taking can be impacted by intranasally administered OT, although it does not explain the relationship between naturally occurring levels of OT and risk-taking (Bozorgmehr et al., 2019).

Although the findings on OT research are particularly intriguing, a recent article examined the publications of one research lab based upon whether the findings were significant or null. This article revealed that although the lab did have significant findings for four studies out of eight, only one of the studies reporting null findings was published and all four of the studies that reported significant findings were published (Lane, Luminet, Nave, & Mikolajczak, 2016). This indicates that there could be a strong publication bias within the OT literature. This article also addressed the problem within the literature of contradictory findings, which make the theoretical framing of OT research confusing and difficult to understand. They discussed the possibility that the impact of OT on behavior might rely heavily upon personality traits and contextual factors (Lane et al., 2016; Bartz, Zaki, Bolger, & Ochsner, 2011). Another potential problem with interpreting the results of OT research, is that when intranasal OT is administered, only a small portion of it reaches the cerebral spinal fluid. Leng and Ludwig (2016) proposed that OT that is administered intranasally could potentially impact behavior by influencing peripheral parts of the body (i.e. heart, gastrointestinal system). The authors recommended that in order to identify the true impact of intranasally administered OT, a control group that receives intranasal OT and antagonists should be included in these types of studies. They also suggested ways to reduce publication bias within the OT literature, including preregistration, open availability of data, outlining statistical methods that will be used, and stating the hypothesized outcomes in advance.

Impulsivity and Risk-Taking

Impulsivity has been defined in many different ways throughout the literature and can be simplified as the propensity of an individual to make decisions quickly, with little forethought (Moeller, Barratt, Dougherty, Schmitz, & Swann, 2001). Impulsivity is often linked to decisions that have small short-term rewards, while either sacrificing large long-term rewards, or resulting in destructive long-term consequences. Daruna and Barnes (1993, p. 23) defined impulsivity as “actions which are poorly conceived, prematurely expressed, unduly risky or inappropriate to the situation and that often result in undesirable consequences”. A meta-analysis conducted by Bezdjian, Baker, and Tuvblad (2010) revealed that approximately equal parts of the variance in impulsivity between individuals is due to both genetic and environmental factors. Some of the biological and environmental variables that are implicated in impulsivity include serotonin (Oades et al., 2008), dopamine, the ventral striatum (Forbes et al., 2009), childhood abuse (Brodsky et al., 2001), poor family environment (Tomson-Johanson, Kiivet, Veidebaum, & Harro, 2019), and exposure to MDMA (Ecstasy; Morgan, 1998), among many others. Impulsivity is also considered a diagnostic criterion for many mental health disorders including ADHD, Borderline Personality Disorder, and many others (American Psychiatric Association [APA], 2013). Finally, higher rates of impulsivity have been identified among individuals with psychological disorders in which impulsivity is not a part of the diagnostic criteria, such as Obsessive-Compulsive Disorder (OCD; Grassi et al., 2015), and Post Traumatic Stress Disorder (PTSD; Netto et al., 2016; APA, 2013).

Eysenck and Eysenck (1977) explored the distinct traits that make up impulsivity by utilizing an exploratory factor analysis (EFA). This analysis identified four traits of impulsivity which were labeled Risk-Taking, Non-Planning, Liveliness, and Narrow Impulsivity (I^N) by the

authors. According to these authors, these four traits combine to make up the overall personality trait of impulsivity, which they termed *broad impulsivity* (I^B). In a more recent study conducted by Whiteside and Lynam (2001), EFA was also used to identify four distinct traits of impulsivity; however, these traits were labelled Lack of Premeditation, Lack of Perseverance, Urgency, and Sensation Seeking. Descriptions of the traits of impulsivity defined by both studies are displayed in Table 3.

Table 3. Comparison of Impulsivity Traits

	Eysenck & Eysenck (1977)		Whiteside & Lynam (2001)
Risk-Taking	Inclination to seek out adventure, excitement and to take risks when faced with the chance of loss.	Premeditation	Ability to delay action in order to weigh consequences
Non-Planning	Preference for spontaneous, unplanned events over those that are structured and planned.	Perseverance	Ability to work until a task is completed
Liveliness	Ability to quickly put thought into action.	Urgency	Inclination to make poor decisions quickly while experiencing negative emotions
Narrow Impulsivity	Impatience and inclination to act without forethought.	Sensation-Seeking	Inclination to seek out adventure and excitement.

In addition to the two different viewpoints of impulsivity proposed by the researchers named above, Dickman (1990) used factor analysis to determine that impulsivity can be split into subtypes based on the outcomes; more specifically, he identified that there is functional impulsivity and dysfunctional impulsivity. Functional impulsivity is defined as acting with little forethought when this type of behavior is beneficial; dysfunctional impulsivity is acting with little forethought when this type of behavior results in difficulties or problems. Interestingly, there was a low correlation (.07) between these two factors or types of impulsivity, indicating that they are in fact, two distinct traits. Both types of impulsivity demonstrated significant correlations with previously developed measures of impulsivity, including the Eysenck Personality Inventory – Extraversion scale (EPI-I) , the Barratt Impulsivity Scale (BIS), the

Narrow Impulsivity Scale (Narrow-I), and the Personality Research Form – Impulsivity Scale (PRF-I); however, dysfunctional impulsivity was more strongly related to the EPI-I, Narrow-I, and PRF-I. Both dysfunctional and functional impulsivity were equally correlated to the BIS.

Dysfunctional impulsivity has been the focus of extensive research due to its relationship with many problem behaviors, including aggressive driving (Kováčsová, Lajunen, & Rošková, 2016), binge drinking (Adan, 2012), physical aggression (Vigil-Colet, Morales-Vives, & Tous, 2008), and suicide attempts (Liu, Wang, Qiu, Xu, & Jia, 2017). On the other hand, functional impulsivity has been identified as a trait that is involved in correctly choosing actions that will be rewarded. Smillie and Jackson (2006) hypothesized that individuals high in functional impulsivity would have a sensitivity to reinforcement as described by Gray's Theory of Reinforcement Sensitivity (1970). Although Gray's theory did not relate directly to impulsivity, he proposed that more introverted-neurotic individuals would have a greater sensitivity to punishment, and that more extroverted-neurotic individuals would not. Alternatively, Smillie and Jackson hypothesized that individuals with high functional impulsivity would have greater sensitivity to reinforcement than individuals with high levels of dysfunctional impulsivity. A striking revelation of this study was that individuals with high functional impulsivity demonstrated a greater sensitivity to actions that would be rewarded; while individuals with high dysfunctional impulsivity exhibited no increased sensitivity towards punishment or rewards (Smillie & Jackson, 2006). These findings indicate that individuals with high levels of dysfunctional impulsivity may be more likely to engage in actions that may be punished with a very little chance of reward. Although higher reward sensitivity is related to better outcomes (functional impulsivity), high reward sensitivity paired with low punishment sensitivity was found to exist among college students who reported engaging in

aggression (Carlson, Pritchard, & Dominelli, 2013).

In addition to the clear distinction that has been identified between functional and dysfunctional impulsivity, White and colleagues (1994) divided impulsivity into behavioral and psychological traits which they termed cognitive and behavioral impulsivity. Cognitive impulsivity in this study was measured by participant performance on tasks meant to measure an individual's mental control and accuracy of time perception, such as time estimation and executive function tasks. Behavioral impulsivity was gauged through tasks that were meant to measure an individual's behavioral control and ability to inhibit responses. Subjects with high cognitive and behavioral impulsivity as measured by these tasks reported having engaged in more delinquent and aggressive behaviors than individuals with low cognitive and behavioral impulsivity. Furthermore, IQ was significantly related to both cognitive and behavioral impulsivity; however, when controlling for IQ, cognitive impulsivity was not significantly related to delinquency or aggression. This finding is interesting because it shows that there is a unique relationship between IQ and cognitive impulsivity, although this relationship is not present in the relationship between IQ and behavioral impulsivity (White et al., 1994).

Risk-taking is often described as one of the many manifestations of impulsivity, and is linked to a variety of negative outcomes, such as unsafe sex practices, substance use, and aggression; however, risk-taking can lead to positive outcomes as well. Byrnes, Miller, and Schafer (1999) defined risk-taking as a behavior that has more than one possible outcome, with some of the possible outcomes being undesirable or potentially harmful. Risk-taking is considered maladaptive if there are more possible negative outcomes than positive, and adaptive risk-taking is when there are more positive outcomes than negative outcomes. This idea is strikingly similar to the concepts of functional and dysfunctional impulsivity as previously

mentioned (Dickman, 1990). It has been established throughout the literature that males tend to engage in risk-taking more frequently than females (Byrnes et al., 1999; Charness & Gneezy, 2012). More recent publications have challenged this idea by criticizing research methods and lack of data regarding *individual* risk-taking behaviors (Nelson, 2016). Risk-taking can be present in several different areas of a person's life including financial matters (Kuhnen & Knutson, 2005), sexual behaviors, social relationships, and business decisions (Hoskisson, Chirico, Zyung, & Gambeta, 2017), among others.

There has been some disagreement across the literature about the true nature of risk-taking behavior. Some researchers have referred to risk-taking as more of a static trait, while others have used a framework in which risk-taking is seen as a product of environment or circumstances (Mishra, Barclay, & Sparks, 2017). For example, some researchers view risk-taking as having origins in personality and is relatively stable over time (Zuckerman & Kuhlman, 2000; Eysenck & Eysenck, 1977). Alternatively, other views of risk-taking propose that risk-taking is a product of analyses of costs and benefits, as well as environmental factors and circumstances. Risk Sensitivity Theory (RST) was developed by researchers who were interested in risk-taking of animals while foraging. These researchers proposed that risk-taking was most often used during foraging when low-risk methods of foraging were unlikely to support survival and procreation. RST is considered a needs-based model of risk-taking, in which individuals engage in risk-taking when faced with circumstances that may not provide enough resources for survival (Stephens, 1981; Stephens & Krebs, 1986; Kacelnik & Bateson, 1997). Similarly, ability-based models of risk-taking hypothesize that individuals take risks if they can afford to do so because of their resources or abilities. For example, individuals who have more money could afford to engage in purchasing risky stocks, while someone with less financial resources would

not make the same choice because the potential costs would outweigh the benefits (Jellison & Riskind, 1970). Additionally, Mishra and colleagues (2017) proposed the Relative State Model of risk-taking, which incorporates both needs-based and ability based models of risk-taking; this model hypothesized that individuals engage in risk-taking depending upon their relative state (present status based on the individual's perspective), perceived likelihood of positive or negative outcomes, and the weight of potential gains and losses.

Many individual factors have been identified as being related to risk-taking behaviors; these include biological influences, personality characteristics, and exposure to toxins or injury. Biological sex has been identified as a predictor of risk taking, with adolescent boys being 3.5 times more likely to engage in high levels of risk-taking than adolescent girls. Additionally, prenatal exposure to cocaine was found to be related to increased risk-taking among boys, although this pattern was not found among girls (Allen, Bennett, Carmody, Wang, & Lewis, 2014). Interestingly, recent research has also uncovered that testosterone and cortisol appear to interact in a way that impacts risk-taking among both males and females, but only when cortisol levels are low (Mehta, Welker, Zilioli, & Carré, 2015). Although traumatic brain injury (TBI) is often associated with impulsive-aggressive outbursts, a compelling study conducted by Fecteau and colleagues (2013) found that individuals who were hospitalized for severe TBI engaged in less risk-taking than healthy individuals during a computerized task used to measure risk-taking. Additionally, although people typically increase in risk-taking across the span of the computerized task that was used, the participants with severe TBI did not demonstrate this pattern of performance.

In addition to the previously mentioned internal factors, risk-taking has also been linked to a variety of environmental and social variables. Recent research has identified an interesting

link between financial inequality and risk-taking behavior; groups of participants who were exposed to more inequality in the outcome of a financial game took greater risks. The authors proposed that individuals who observed greater inequality took greater risks because of a perception that they needed to earn more, possibly to “catch up” (Payne, Brown-Iannuzzi, & Hannay, 2017). Additionally, during a study in which participants experienced rejection by a member of their own race or a member of another race, individuals who experienced what could be interpreted as discrimination engaged in more risk-taking during subsequent tasks; they also rated themselves as being more angry and exhibited more physical symptoms of anger (Jamieson, Koslov, Nock, & Mendes, 2013). Furthermore, family unpredictability in childhood has been identified as a predictor of risk-taking behavior; unpredictability of meals, nurturance, and discipline have been significantly related to risk-taking behavior as measured by a rating scale created by Hill and colleagues (1997). This rating scale asks individuals how frequently they are involved in risky behaviors such as unsafe sex practices, risky drug and alcohol use, and other high-risk behaviors such as driving a motorcycle. Interestingly, discounting distant future outcomes had a direct effect on risk-taking, as well as mediated the relationship between family unpredictability and risk-taking. This finding demonstrates that family unpredictability, future discounting, and risk-taking behavior are intertwined with one-another in a complex relationship (Hill, Jenkins, & Farmer, 2008).

Hypotheses and Proposed Analyses

Several implications can be parsed from the previously discussed literature; within the context of outcomes for survivors of childhood maltreatment, these implications construct a cohesive narrative which guided the purpose of the present study. This narrative inspired the hypotheses of this study by considering the following facts which were previously discussed: (a)

children with maltreatment experiences face a variety of negative outcomes regarding their emotional, behavioral, and physical health; (b) severity of maltreatment *and* certain characteristics of maltreatment (number of forms experienced, type of maltreatment) are differentially linked to poor outcomes; (c) severity of maltreatment and characteristics of maltreatment are related to differences in OT levels; (d) differences in levels of OT and intranasal administration of OT have previously been associated with impulsivity, risk-taking, and other negative outcomes (suicidality, aggression); and (e) high impulsivity and risk-taking are linked to substance use, criminal behavior, and risky health behaviors. In essence, this study proposes the biological changes that we see in those who have experienced maltreatment, engender changes in underlying behavioral traits that lead to unfavorable outcomes. The reason that this question is important to answer, is because although many survivors of maltreatment are able to escape those who caused them harm in childhood, they continue to experience the impact of maltreatment throughout their lives.

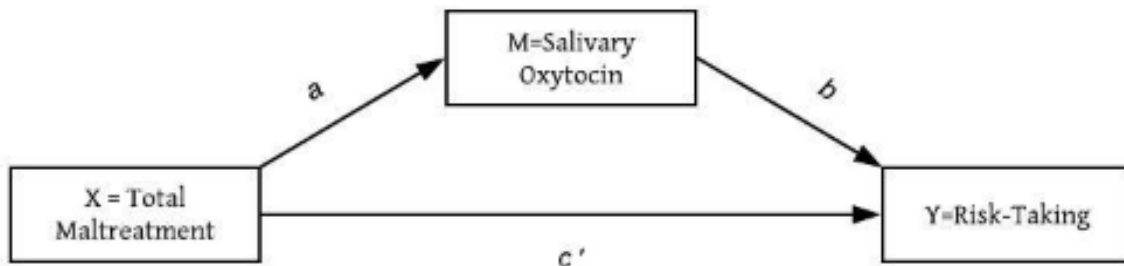
Eight interrelated hypotheses were formed based upon this central idea, with a specific focus on the impact of (a) maltreatment severity on OT levels and risk-taking; (b) the number of forms of maltreatment experienced on OT levels and risk-taking; (c) emotional maltreatment experiences on OT and risk-taking; and (d) emotional abuse on OT and risk-taking. Each of these hypotheses were analyzed using a simple mediation regression model.

Childhood Maltreatment. Two hypotheses were formed to test the questions surrounding the relationship between overall childhood maltreatment, oxytocin, and risk-taking. Both hypotheses are presented below, and the model used to test these two hypotheses is displayed in Figure 1.

Hypothesis 1a: Individuals who reported higher overall levels of childhood maltreatment will have lower levels of salivary OT.

Hypothesis 1b: Lower salivary OT will be associated with higher levels of risk-taking as measured by the IGT.

Figure 1.

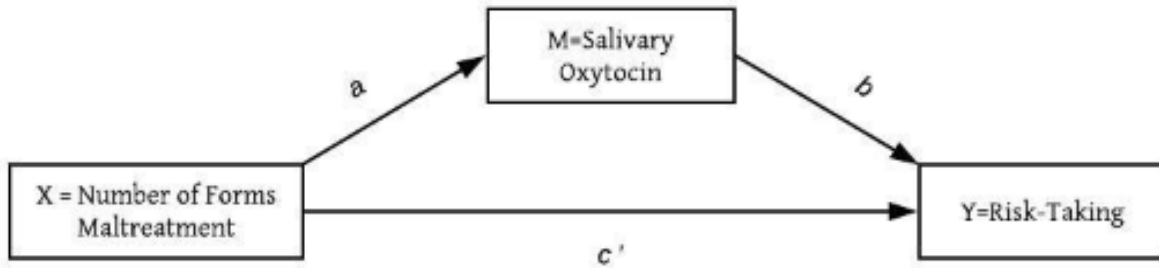


Forms of Maltreatment. Similarly, two hypotheses were formed to test the questions surrounding the relationship between the number of forms of maltreatment (physical abuse, physical neglect, emotional abuse, emotional neglect, and sexual abuse) an individual has experienced, oxytocin levels, and risk-taking. Both hypotheses are presented below, and the model used to test these two hypotheses is displayed in Figure 2.

Hypothesis 2a: Individuals who reported having experienced more forms of childhood maltreatment will have lower levels of salivary OT.

Hypothesis 2b: Lower salivary OT will be associated with higher levels of risk-taking as measured by the IGT.

Figure 2.

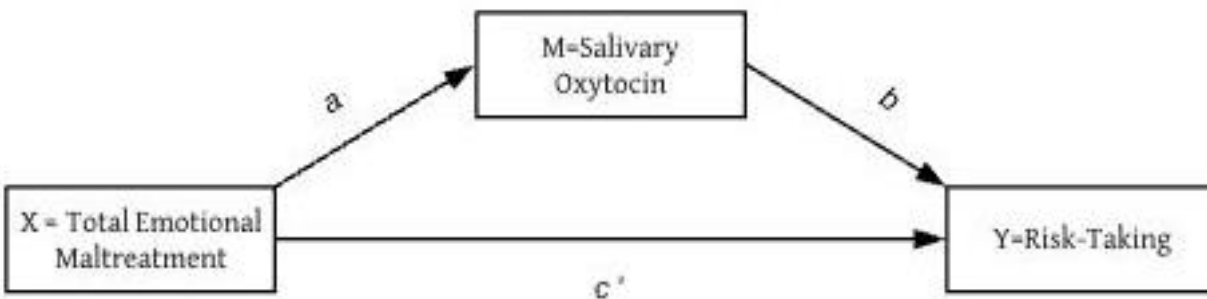


Total Emotional Maltreatment. Two hypotheses were formed to answer the questions surrounding the relationship between overall emotional maltreatment, OT levels, and risk-taking. Both hypotheses are presented below, and the model used to test these two hypotheses is displayed in Figure 3.

Hypothesis 3a: Individuals who experienced more emotional maltreatment as children (neglect and abuse) will have lower levels of salivary OT.

Hypothesis 3b: Lower salivary OT will be associated with higher levels of risk-taking, as measured by the IGT.

Figure 3.

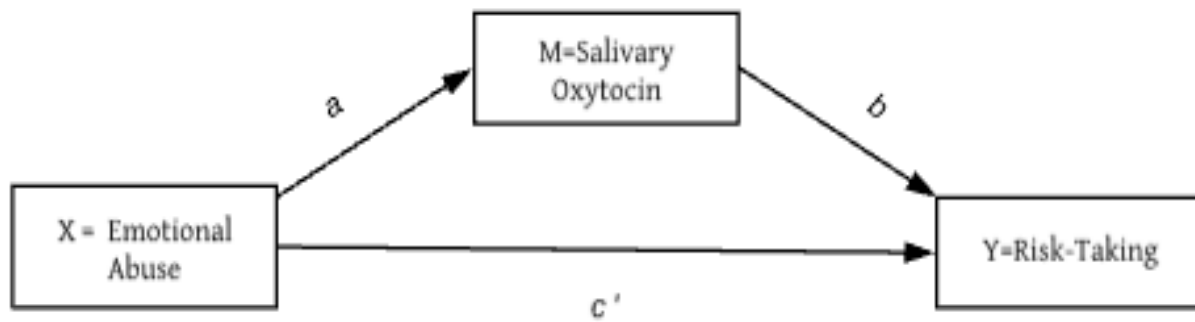


Emotional Abuse. Finally, two hypotheses were made about the relationship between experiences of emotional abuse, salivary OT levels, and risk-taking.

Hypothesis 4a: Individuals who experienced more emotional abuse will have lower levels of salivary OT.

Hypothesis 4b: Lower salivary OT will be associated with higher levels of risk-taking as measured by the IGT.

Figure 4.



Chapter II: METHODS

Procedures

All procedures were reviewed and approved by the University and Medical Institutional Review Board (UMCIRB) prior to any data collection or recruitment. Procedures that applied specifically to participants in the group of young adults on probation were also reviewed and approved by the local state Department of Public Safety (DPI), given that this population is especially vulnerable. Throughout data collection and storage, measures were taken to protect confidentiality and privacy of participants, and it was made clear that the participants could discontinue the study at any time.

Participants

Participants in this study were recruited in two different ways, with approximately half of the sample being made up of college students ($n=47$) and the other half being made up of young adults on probation ($n=54$). Individuals were excluded from participation in this study if they (a) did not speak English, (b) had not received more than an 8th grade education, (c) had been previously diagnosed with an intellectual disability, and/or (d) had previously been diagnosed with a mental disorder including psychosis as a part of the diagnostic criteria in the DSM-V. Although these were the only exclusionary criteria initially used, data screening later identified four other participants that were removed from analyses due to various factors which will be discussed later.

College students that participated in the study were recruited through an introductory psychology course at a large, southeastern, public university. As a part of this course, students could choose to participate in a research study or write a short paper for 5% of their final grade. Many research opportunities were provided throughout the semester, and students were able to

choose those that interested them. Students were considered eligible for the study if they endorsed having experienced one or more adverse experiences in childhood (Felitti et al., 1998). In contrast, young adults on probation were recruited through two different probation offices in the southeastern United States. There was no prerequisite for this population regarding experiences with adverse experiences; however, most participants in this group reported a history of childhood maltreatment. These individuals were notified by a probation officer before or after a scheduled meeting that they would be eligible to participate in this study if they wished. It was made clear to individuals that they would be free to decline the invitation to participate with no negative consequences. It was further emphasized that participation in this study would not affect their probation or parole terms in any way. If probationers stated that they were interested in participating in the study, the probation officer showed them to a private conference room where data were collected by the primary investigator and/or research assistants.

All 101 recruited participants completed several written measures including a demographics questionnaire, the *Childhood Trauma Questionnaire – Short Form* (CTQ-SF), and a recent stressful life-event questionnaire. Participant responses were then screened to identify factors that could introduce confounding variables into the data. Two participants who endorsed being pregnant or breastfeeding at the time of the study were excluded from data analyses due to the empirically supported relationship between pregnancy/breastfeeding and OT levels (Grewen, Davenport, & Light, 2010; Levine, Zagoory-Sharon, Feldman, & Weller, 2007). Additionally, two participants were excluded from the final data analyses due to having endorsed the highest scores on all minimization items of the CTQ-SF, indicating that it is *very likely* that these individuals were presenting their childhood in an overly positive light. High scores on these items indicate that the participants reported having the perfect childhood, that they never wanted

to change anything about their family, and that they had the best family in the world (Bernstein & Fink, 1998; MacDonald, Thomas, MacDonald, & Sciolla, 2015).

The final sample size for this study is made up of 53 young adults on probation, and 44 undergraduate college students ($N=97$), which is 96% of the original sample. Age, race, and gender varied significantly between the two population groups included in this study. For this reason, age, race, and gender were included as covariates in the final data analyses. The average age of the college students was 19.6 years ($SD=1.1$), while the average age of young adults on probation was 24 years ($SD=3.5$). Of particular importance, is the overrepresentation of females ($n=27$, 62.4%) and white/Caucasian individuals ($n=28$, 63.3%) in the group of college students; and the overrepresentation of males ($n=42$, 79.2%) and African Americans ($n=31$, 58.5%) in the group of young adults on probation. There were only two individuals who identified as being multiracial (2.1%), one individual who identified as being Latino/Hispanic (1.0%), and one individual who identified as being of another race/ethnicity (1.0%). Additionally, all participants reported that they identified as being either male or female, rather than nonbinary or transgendered. Out of this total sample of 97 participants, 24 individuals reported suffering from a mental health diagnosis or diagnoses. The variable used to measure mental health diagnoses was employed in analyses as a covariate to reduce the impact of any associated confounding factors. Data regarding the total sample and the sample divided by group (students or young adults on probation) are displayed in Table 4 and Table 5.

Table 4. Demographic Information

Total Sample – Demographics					
	<u>Sex</u>	<u>Race/Ethnicity</u>		<u>Group</u>	
Male	59 (60.8%)	White	47 (48.5%)	College Student	44 (46.5%)
Female	38 (39.2%)	Black/African American	46 (47.4%)	Young Adult Prob.	53 (53.5%)
Transgender	0 (0%)	Latino/Hispanic	1 (1.0%)		<u>Age</u>
Other	0 (0%)	Multiracial	2 (2.1. %)	<i>M</i>	21.7 years
		Other	1 (1.0 %)	<i>Mode</i>	18 years
				<i>Mdn</i>	23.5 years

Table 5. Demographics by Group Membership

Demographics by Group – Comparison						
	<u>Young Adult – Undergraduate Students</u>			<u>Young Adults on Probation</u>		
Sex	Male	17 (38.6%)		Sex	Male	42 (79.2%)
	Female	27 (62.4%)			Female	11 (20.8%)
	Transgender	0 (0%)			Transgender	0 (0%)
	Other	0 (0%)			Other	0 (0%)
Race	White/ Caucasian	28 (63.6%)			White/Caucasian	19 (35.8%)
	Black / African American	15 (34.1%)			Black /African American	31 (58.5%)
	Multiracial	0 (0%)			Multiracial	2 (3.8%)
	Latino/ Hispanic	0 (0%)			Latino/ Hispanic	1 (1.9%)
	Other	1 (2.3%)			Other	0 (0%)
Age	<i>M</i>	19.6 years		Age	<i>M</i>	24.0 years
	<i>Mdn</i>	19.2 years			<i>Mdn</i>	24 years
	Range	18.5-21.9 years			Range	18 - 29 years

Measures

Demographics Questionnaire. All participants completed a demographics questionnaire which asked about participant gender, age, relationship status, current living arrangements and medical/mental health history. This questionnaire also asked about current and past relationships with parents and caregivers, as well as changes in caregivers. One question addressed current illegal drug and prescription drug use. Additionally, there are three questions at the end of the survey for female participants which asks about last menstrual cycle, birth-control, pregnancy, and breastfeeding. The demographics questionnaire allowed for efficient identification of

possible confounding factors (pregnancy/breast feeding, mental health diagnoses), which allowed the researchers to decide the most scientifically sound method of addressing these variables. The demographics questionnaire also provided important descriptive information that could be used to form a fuller understanding of the findings.

Recent Stressful Life Event Scale. All participants completed a questionnaire designed to assess current level of stress by measuring the number of negative events (i.e. got fired, arrested) or changes (i.e. new baby, got married, changed schools) that occurred within the last 12 months. This questionnaire lists 28 different life events, which participants would simply check off. Scores were obtained by adding up the number of events endorsed by participants. Higher, number of endorsed items would typically be associated with higher levels of stress. Scores on the Recent Stressful Life Event scale were used as a covariate during the analyses due to recent literature that has revealed that salivary OT levels can fluctuate when performing a social stress test (de Jong et al., 2015). Although this study was more relevant to immediate stress, it is possible that chronic or major life stressors could also impact OT levels.

Maltreatment History. The Childhood Trauma Questionnaire (CTQ) is a 28-item, retrospective, self-report questionnaire which is used to assess past experiences of child abuse among adults and adolescents. Researchers have uncovered evidence that strong validity and reliability of the CTQ exists among clinical and community samples (Bernstein, Ahluvalia, Pogge, & Handelsman, 1997; Berstein et al., 1994). Each of the items of the CTQ includes a statement (i.e. called names by family) and asks the participant to rate the truth of the statement on a scale from one to five, with one being *never true* and five being *very often true*. The scores of each item add up to create scores to reflect an individual's past experiences of physical abuse, emotional abuse, emotional neglect, physical neglect, and sexual abuse (Bernstein & Fink,

1997). Confirmatory and exploratory factor analysis have both pointed to this five-factor model as the most appropriate fit for explaining the data obtained by the CTQ (Scher, Stein, Asmundson, McCreary, & Forde, 2001).

All participants in this study were asked to complete the CTQ-SF on site where they were recruited. Participants complete the CTQ-SF in a quiet, private room, and they were advised that their answers would be kept anonymous; the rating scale takes approximately 5-10 minutes to complete. Although participants were advised that their answers would be anonymous, it is possible that some individuals were not completely honest or accurate given the sensitive nature of the questions, or due to these questions referring to events that happened prior to 18 years of age. Two participants endorsed scores that indicated that it was *very likely* that they were minimizing adverse experiences in childhood. These two individuals were removed from data analyses.

Risk-Taking. The Iowa Gambling Task (IGT), a computerized card game used to measure decision making, was completed by all participants. Individuals completing this task start out with \$2,000 play/computerized dollars and attempt to gain money throughout the task over a series of 100 card draws. The individuals can draw the cards from one of four decks, including decks A and B, which are considered disadvantageous or risky, and decks C and D which are considered safer and more advantageous over time. Individuals who choose cards more frequently from decks A and B lose more money on average than individuals who frequently choose cards from decks C and D (Buelow & Suhr, 2009). The IGT was assessed as a measure for impulsivity in a sample of low-income children in a school setting. Teachers ratings on the Barrett's Impulsiveness Scale for these students indicated that children with higher impulsivity scores performed more poorly on the IGT (Burdick, Roy, & Raver, 2013). The IGT

is significantly correlated with another computerized measure of risk-taking, The Balloon Analogue Risk Task (BART); however, these correlations only exist for the later stages of the IGT. This is assumed to be due to a learning curve that is associated with the IGT (Xu, Korczykowski, Zhu, & Rao, 2013). For this reason, only the scores from the last two blocks of the IGT were included in data analyses. Participant risk-taking scores during this study were computed by subtracting the number of risky deck selections from the number of safe deck selections. This resulted in individuals who engaged in more risk-taking during the IGT having lower scores.

Samples of Salivary Oxytocin

All participants donated a sample of saliva by following specific instructions. Participants were asked to allow saliva to pool in the mouth without swallowing for one minute, and then to donate the saliva into a 2 milliliter cryovial using a straw-like collection device manufactured by Assay Designs. OT in plasma samples has demonstrated to have a short half-life (1- 6 minutes), and for this reason participants were given a maximum of three minutes to donate at least a 1 mL sample of saliva (Grewen et al., 2010). One mL of saliva was the amount needed to be able to conduct duplicate analyses of each sample. After collection, the saliva samples were immediately put on ice in a cooler and taken to the Behavioral Neuroscience lab at East Carolina University. These samples were stored in a freezer at a temperature of -79°C until they were shipped overnight to the Stress and Health Research Lab in the Psychiatry Department at the University of North Carolina in Chapel Hill. Upon arrival at the Stress and Health Research Lab, OT was assayed from each saliva sample using an Oxytocin Enzyme Immunoassay (EIA) kit designed by Enzo Life Sciences. This kit uses an updated version of test procedures which were developed by Carter and colleagues (2007) for the testing and validation of salivary OT levels. The original

procedure in this study was conducted using an EIA kit designed by Assay Designs, which reported very low cross-reactivity of similar neuropeptides of less than .001%, indicating that there is a very low chance that the test results were impacted by another bodily chemical.

Samples were analyzed according to the kit's instructions, as follows:

Equilibrate a strata-X 33 μ m polymeric reversed phase SPE sorbent in a 96-well plate containing 60 mg sorbent per well, Phenomenex, Torrance CA, by adding 1 ml MeOH followed by 1 ml of water. Acidify 0.8ml of plasma with .4 ml of 1.5% trifluoroacetic acid (TFA) and centrifuge at 6,000 x g for 20 minutes at 4°C. Load this supernatant onto the pre-treated strata-X plate. Slowly wash the wells with 1.5 ml of 0.1% TFA, and then elute the peptide with 1 ml of 80% acetonitrile. Collect eluant in a polystyrene tube and evaporate to dryness under a N₂ stream. Reconstitute the residue in 250 μ l of assay buffer. Extraction efficiency was 94%, as determined by spiking a sample with a known amount of hormone and extracting with the other samples.

The EIA kit used for assay in this study, uses a different OT antibody than what was used in research prior to 2006. This antibody requires that saliva samples to be extracted and concentrated 3.2 times, as opposed to 4 times (Carter et al., 2007; Grewen et al., 2010). This difference in saliva concentration causes reported OT levels to be lower than those provided by the kit which was used before 2006. The added step of extraction ensures that the OT levels in the saliva are detectable by ensuring that they are above the lower limit for sensitivity, which is 2.0 picograms per milliliter. All saliva samples were incubated overnight at a temperature of 4°C prior to rinsing reagents and then incubating the bound oxytocin phosphatase with substrate. During this incubation, an enzyme reaction occurs which generates a yellow color. After one

hour, this process is stopped, and the results can be interpreted by observing the color produced by each sample. Brighter yellow colors are associated with lower OT levels, while more dull yellows are associated with higher OT levels. The optical density of each sample, representative of the OT content in the saliva in picograms per milliliter, was read on a Sunrise plate reader (Tecan, Research Triangle Park, NC), and then each value was plotted against a normal curve. Immunoassay software supplied by the plate reader manufacturer (SoftMax Pro) was used to manage data obtained from the saliva samples. The Enzo Life Sciences assay kit and protocol were used throughout this process.

Criminal offense history.

All conviction and sentence information for adult offenders in NC (with a history of either community corrections services or incarceration) was gathered from the NC Department of Public Safety (NCDPS) Offender Public Information website (<http://webapps6.doc.state.nc.us/opi/offendersearch.do?method=list>). Data was collected on participants' total number of offenses, crime classification, felony/misdemeanor status, and number of previous incarcerations. Additionally, in the group of college students, no data on criminal history was collected.

Data Analyses.

Data were analyzed using IBM SPSS Version 25 statistical software; data screening was initially completed to check for crucial features such as missing data, normality, outliers, and homoscedasticity. Furthermore, in order to manage missing data, multiple imputation (MI) was used. MI is considered to be a best practice for handling missing data; although MI can be time consuming, it was an ideal option for handling missing data in this case because the data set is relatively small. Although a small number of imputations has been supported as being sufficient

in the literature, a recent study determined that in some cases, a larger number of imputations provides more accurate estimates (Johnson & Young, 2011). For the present study 50 imputed values were generated. When MI is used, effect sizes cannot be generated; confidence interval parameter estimates for the indirect effects for each model were calculated by using a 95% Monte Carlo confidence interval (Selig & Preacher, 2008) Finally, main effects were tested through use of a series of simple mediation regression models, and indirect effects were explored by multiplying the slopes of path *a* and path *b* for each model.

CHAPTER III: RESULTS

Data Screening and Missing Data

Data screening revealed that the residuals of the primary outcome variables met the assumptions of linear regression; examinations of P-P and Q-Q scatterplots demonstrated that the data possessed both normality and homoscedasticity. Among the primary outcome variables, only IGT scores had outliers, which was expected due to the format of the task and wide range of scores that can be obtained based upon participant performance. Primary and control variables used during these analyses are described in Table 6, while descriptive statistics and correlations are displayed in Tables 7 and 8.

Table 6. Descriptions of Primary Variables and Covariates

Variable Name	Description
TotMal	Participants overall maltreatment scores on the CTQ
TotForms	Number of forms of maltreatment experienced by participants as defined by CTQ cutoff scores.
TotEmAb	Participants scores relating to emotional abuse experiences on the CTQ.
TotEmMal	Participants scores relating to overall emotional maltreatment experiences on the CTQ.
OXT	Salivary OT levels as measured by picograms per milliliter (pg/ml)
IGT40	Participants scores on the last 40 trials of the IGT
Psyc#dx	Self-reported number of psychiatric diagnoses endorsed by participants.
Stress	The number of recent stressful life events that were endorsed by participants.
Minimiz	Scores on the CTQ that indicate possible minimization of traumatic experiences by participants.
TotOffen	Number of participant's criminal convictions as reported by the NC Department of Public Safety.

Table 7. Descriptive Statistics – Primary Variables and Covariates

Variable	<i>M</i>	<i>SD</i>	<i>Skew</i>	<i>Kurtosis</i>
TotalMal	47.91	16.32	.21	-1.20
TotForms	2.36	1.73	-.09	-1.47
EmAb	11.16	5.45	.35	-1.18
TotEmMal	23.27	9.84	.15	-1.28
OXT	17.48	8.39	.71	-.26
IGT40	8.26	13.28	.24	.49
Psyc#dx	.40	.86	2.50	6.33
Stress	4.42	2.60	.32	-.02
Minimiz	.31	.64	1.87	2.10
Totoffen	2.46	3.71	1.80	2.31

Table 8. Zero Order Correlations

Variable	TotMal	TotForms	EmAb	TotEmMa	OXT	IGT40	Psyc#dx	Stress	Minimize	TotOffen
TotMal	---	---	---	---	---	---	---	---	---	---
TotForms	.91**	---	---	---	---	---	---	---	---	---
EmAb	.84**	.77**	---	---	---	---	---	---	---	---
TotEmMal	.92**	.84**	.92**	---	---	---	---	---	---	---
OXT	-.13	-.10	-.14	-.19	---	---	---	---	---	---
IGT40	-.12	-.06	-.22*	-.17	.15	---	---	---	---	---
Psyc#dx	.11	.06	.20*	.20*	.11	-.02	---	---	---	---
Stress	.28**	.23*	.38**	.36**	.15	-.06	.09	---	---	---
Minimiz	-.43**	-.45	-.37**	-.47	.03	-.03	-.14	-.26*	---	---
TotOffen	-.13	-.12	-.14	-.07	-.38**	-.07	.05	-.15	-.05	---

$p \leq .05$ *, $p \leq .01$ **

Screening for missing data revealed that 11.34% of the participants were missing at least one value from the data set; however, only 1.63% of the total data collected was missing. Seven individuals were missing data for the IGT task due to time concerns at the time of data collection (they were not asked to complete the task). Additionally, four individuals were missing data on

OT levels due to being unable to produce enough saliva in the allotted time during data collection.

Analyses of Hypotheses

Hypotheses 1a and 1b. The present study hypothesized that (a) individuals who report higher overall levels of childhood maltreatment would have lower levels of salivary OT, and (b) that these differences in salivary OT levels would predict performance on the IGT. Specifically, Hypothesis 1b stated that lower salivary OT would be associated with more selections from the high-risk card decks on the IGT. A simple mediation regression model with CTQ maltreatment scores, salivary OT levels, and IGT selections (Model 1), was fit. As hypothesized, total maltreatment predicted salivary OT levels ($a = -.123, p = .030$); individuals who reported experiencing more overall maltreatment had lower levels of salivary OT. In contrast, there was no effect of OT levels on risk-taking ($b = .259, p = .300$), and no overall effect of maltreatment on risk-taking when OT was controlled for ($c' = -.145, p = .228$). Generally, maltreatment had no effect on risk-taking during the IGT. Slopes, standard error, confidence intervals for the slope, and p values are displayed in Table 5. Because MI was used to manage missing data, an effect size could not be generated; confidence interval parameter estimates for the indirect effects for each model were calculated by using a 95% Monte Carlo confidence interval (Selig & Preacher, 2008). This confidence interval is included in Table 9.

Table 9. Hypotheses 1a and 1b

		Model 1 Coefficients										
		<i>M (Oxytocin)</i>					<i>Y (IGT Score)</i>					
Predictor		<i>b</i>	<i>LLCI</i>	<i>ULCI</i>	<i>se</i>	<i>p</i>	<i>b</i>	<i>LLCI</i>	<i>ULCI</i>	<i>se</i>	<i>p</i>	
<i>X (Total Mal.)</i>	<i>a</i>	-.12	-.23	-.01	.06	.030	<i>c</i>	-.15	-.38	.09	.12	.228
<i>M (Oxytocin)</i>		-	-	-	-	-	<i>b</i>	.26	-.23	.75	.25	.300
<i>Indirect Effect = -.03</i>												
<i>CI Parameter Estimates of Indirect Effect = -.12, .03</i>												

Hypotheses 2a and 2b. These hypotheses stated that (a) individuals who experienced more forms of childhood maltreatment (physical abuse, physical neglect, emotional abuse, emotional neglect, and sexual abuse) would have lower levels of salivary OT, and (b) that these differences in salivary OT levels would predict performance on the IGT. Again, from information drawn from the literature it was expected that experiencing more forms of maltreatment would predict more risky decision-making on the IGT. A simple mediation regression model with the number of forms of maltreatment experienced, salivary OT levels, and IGT selections (Model 2) was fit. In contrast with Hypothesis 2, the number of forms of maltreatment experienced by participants did not predict salivary OT levels ($a = -1.03, p = .060$); there was no difference in salivary OT levels among individuals who reported experiencing more forms of maltreatment. Similarly, there was no effect of OT levels on risk-taking ($b = .29, p = .245$), and no overall effect of maltreatment on risk-taking when controlling for salivary OT ($c' = -.88, p = .428$). Slopes, standard error, confidence intervals for the slope, confidence intervals for parameter estimates of the indirect effect, and p values are displayed in Table 10.

Table 10. Hypotheses 2a and 2b

		Model 2 Coefficients										
		<i>M (Oxytocin)</i>					<i>Y (IGT Score)</i>					
Predictor		<i>b</i>	<i>LLCI</i>	<i>ULCI</i>	<i>se</i>	<i>p</i>	<i>b</i>	<i>LLCI</i>	<i>ULCI</i>	<i>se</i>	<i>p</i>	
<i>X (Tot Forms)</i>	<i>a</i>	-1.03	-2.11	.05	.55	.060	<i>c'</i>	-.88	-3.05	1.30	1.11	.428
<i>M (Oxytocin)</i>	-	-	-	-	-	-	<i>b</i>	.29	-.20	.77	.25	.245
<i>Model 2 Indirect Effect = -0.30</i>												
<i>CI Parameter Estimates of Indirect Effect = -1.07, .21</i>												

Hypotheses 3a and 3b. These hypotheses stated that individuals who reported higher overall levels of emotional maltreatment would (a) have lower levels of salivary OT, and (b) that these differences in salivary OT levels would predict performance on the IGT. Specifically, it was suspected that lower salivary OT would be associated with more risky decision-making

during the IGT. A simple mediation regression model with CTQ total emotional maltreatment scores, salivary OT levels, and IGT selections (Model 3), was fit. As hypothesized, there was a direct effect of total emotional maltreatment experienced on salivary OT levels ($a = -.32$, $p = .001$). Specifically, individuals who experienced more emotional maltreatment had lower levels of salivary OT. In contrast, there was no effect of OT levels on risk-taking ($b = .23$, $p = .202$) and no effect of emotional maltreatment on risk-taking when controlling for OT ($c' = -.222$, $p = .318$). Generally, there was no effect of total emotional maltreatment on risk-taking. Slopes, standard error, confidence intervals for the slope, confidence intervals for parameter estimates of indirect effects, and p values are displayed in Table 7.

Table 11. Hypotheses 3a and 3b

		Model 3 Coefficients										
		<i>M (Oxytocin)</i>					<i>Y (IGT Score)</i>					
Predictor		<i>b</i>	<i>LLCI</i>	<i>ULCI</i>	<i>se</i>	<i>p</i>		<i>b</i>	<i>LLCI</i>	<i>ULCI</i>	<i>se</i>	<i>p</i>
<i>X (TotEmMal)</i>	<i>a</i>	-.32	-.50	-.14	.09	.001*	<i>c'</i>	-.35	-.89	.19	.28	.202
<i>M (Oxytocin)</i>	-	-	-	-	-	-	<i>b</i>	.23	-.37	.83	.31	.456
<i>Model 3 Indirect Effect = -.07</i>												
<i>CI Parameter Estimates of Indirect Effects = -.31, .13</i>												

Hypotheses 4a and 4b. Finally, these hypotheses stated that (a) individuals who reported higher levels of emotional abuse would have lower levels of salivary OT, and (b) that these differences in salivary OT levels would predict performance on the IGT; lower salivary OT would be associated with more risky card selections on the IGT. A simple mediation regression model with CTQ emotional abuse scores, salivary OT levels, and IGT selections (Model 4), was fit. As hypothesized, there was an effect of total emotional abuse experienced on salivary OT levels ($a = -.60$, $p < .001$). Specifically, individuals who experienced more emotional abuse had lower levels of salivary OT. In contrast, there was no effect of OT levels on risk-taking during the IGT ($b = .18$, $p = .553$) and no effect of emotional abuse experiences on risk-taking during

the IGT when controlling for OT ($c' = -.683, p = .084$). Interestingly, emotional abuse scores predicted risk-taking on the IGT when not controlling for OT ($c = -.98, p = .033$); the slope is negative, indicating that individuals who experienced more emotional abuse made less selections from the safe card decks on the IGT. Slopes, standard error, confidence intervals for the slope, confidence intervals for parameter estimates of indirect effects, and p values are displayed in Table 8.

Table 12. Hypotheses 4a and 4b

		Model 4 Coefficients										
		<i>M (Oxytocin)</i>					<i>Y (IGT Score)</i>					
Predictor		<i>b</i>	<i>LLCI</i>	<i>ULCI</i>	<i>se</i>	<i>p</i>		<i>b</i>	<i>LLCI</i>	<i>ULCI</i>	<i>se</i>	<i>p</i>
<i>X (EmAbu)</i>	<i>a</i>	-.60	-.94	-.27	.17	.000*	<i>c'</i>	-.87	-1.84	.10	.49	.078
<i>M (Oxytocin)</i>	-	-	-	-	-	-	<i>b</i>	.18	-.41	.77	.30	.553
<i>Model 4 Indirect Effect = -.11</i>												
<i>CI Parameter Estimates of Indirect Effects = -.51, .25</i>												

CHAPTER IV: DISCUSSION

Summary of Results and Implications

The present study sought to explore OT as a potential mediator in the relationship between past childhood maltreatment and risk-taking behavior. Furthermore, it hypothesized that individuals who have experienced higher levels of overall maltreatment, emotional maltreatment, and emotional abuse would have lower salivary OT levels than individuals who did not; and that individuals who have experienced more forms of maltreatment would have lower OT levels than individuals who experienced fewer forms of maltreatment. Overall, these findings suggest that there is an important link between experiences of childhood maltreatment and salivary OT levels, but that the differences that exist in OT levels do not impact risk-taking as measured by the Iowa Gambling Task. It is important to consider the lack of clarity regarding exactly what construct is measured by the IGT; this is something that should be considered within the context of the present findings. Furthermore, although this study confirmed past research that discovered a link between OT levels and overall maltreatment, emotional abuse, and overall emotional maltreatment; the link between the number of forms of maltreatment and OT levels was not confirmed.

Even though past research has demonstrated that individuals who have experienced maltreatment tend to engage in more risky behaviors, it may not be possible to explain this phenomenon with one trait construct, such as risk-taking. There may be other underlying traits that interact with one another, which result in the negative trajectories and outcomes that are often found among individuals with a history of maltreatment. For example, traits related to risk-taking such as dysfunctional impulsivity (Dickman, 1990), or punishment and reward sensitivity (Gray, 1970), may play a role in how risk-taking manifests among individuals. Because of this,

continued research to explore other traits related to risk-taking may be beneficial. Additionally, using the literature as a theoretical basis to formulate hypotheses structured around more complex mediation models (i.e., serial mediation and moderated mediation) may open the door to a more detailed explanation of the relationship between childhood maltreatment and risky behaviors than a simple mediation model is able to provide.

Limitations

Limitations of the present study were identified throughout the course of a detailed literature review and data analyses. A qualitative discussion of data collection methods, study hypotheses, and data analyses will be offered within the following section; the selected sample, the measures used, some data collection procedures, and the model of analyses are the primary sources in which limitations were identified. Although the present study has several limitations, these flaws were used to inform the discussion of future directions for research, and the author suggests designing future research with these considerations in mind.

Some of the primary limitations of this study originated from the selected sample of participants. Although the study included a sufficient number of participants, a larger sample would have provided more power in subsequent data analyses (Kraemer & Thiemann, 1987). This is especially noteworthy due to recent research that has explored the problem of underpowered studies reporting significant findings among the OT literature, particularly among studies in which OT was administered intranasally (Walum, Waldman, & Young, 2016). Because underpowered studies can impact the likelihood of rejecting the null hypothesis, it would have been especially important to choose the sample or design the data analyses on the basis of obtaining power of $\geq 80\%$ (Walum et al., 2016). In order to achieve power of $\geq 80\%$ with a small or moderate effect size given the number of predictors that were used in this simple

mediation model (primary variables and covariates), the sample size would have to include between 530 and 811 participants depending upon the model (1 – 4), although the present study only included 97 individuals (Faul, Erdfelder, Lang, & Buchner, 2007). This indicates that the present study is underpowered, which could have led to an inappropriate rejection of the null hypotheses. The underpowering of this study is especially problematic, given the possibility of a strong publication bias within the OT literature that was discussed earlier (Lane et al., 2016).

Other complications were also born from the fact that the sample used for this study was one of convenience; the data was originally collected for another study that explored the relationship between OT levels, CU traits, and proactive/reactive aggression (Scott, 2017). Because the primary aim of the present thesis did not delve into criminal or aggressive behavior, the generalizability of the findings is questionable. For example, the original study used probationers due to the focus on proactive and reactive aggression; although in the present study, data relevant to criminal offenses was only used as a covariate. Despite the fact that it is possible to control for some of the differences between the two groups of participants (probationers and college students) it is unlikely that controlling for criminal offenses alone was enough to remove concern about any other potential confounding variables associated with these different life trajectories. Additionally, differences among the two groups of participants could have been an indirect cause of differences in risk-taking behavior during the IGT. For example, although there was no measure of SES for the young adults on probation, the disparities of involvement in the legal system between those of low SES and high SES are well documented throughout the literature (Wooldredge & Thistlethwaite, 2004). Because of the link that has been found between financial inequality and risk-taking behavior during a computerized card task; information about SES would have been especially crucial given that the outcome variable of this study was risk-

taking (Payne et al., 2017). The sample selection also resulted in a sample that was not generalizable to the U.S. population; there was an overrepresentation of African American males in the group of young adults on probation and an overrepresentation of white females in the group of college students.

Some of the limitations of the present study also originated from some of the procedures that were used, including the settings in which data was collected, the method of recruiting participants, and the administration of measures used. The recruiting method is a limitation of this study because participants were able to sign up for the study by using an on-line database or were recruited at the probation office. As past research has demonstrated, males are less likely than females to disclose childhood sexual abuse. For this reason, it is possible that there were more males who had experienced abuse, but that the method of recruitment deterred them from participating in the study (Sorsoli et al., 2008). The impact of more discrete methods of disclosure was demonstrated in a recent study conducted by Barr and colleagues (2017); boys living in Uganda were seven times more likely to disclose past sexual abuse if they were allowed to mark a piece of paper, put it in an envelope, and seal it themselves, as opposed to when they were asked in a face-to-face interview if they had experienced sexual abuse. A limitation related to data collection, is that for some individuals, data collection took place at places where participants could have felt particularly anxious or angry. Although there is no research specifically regarding differences in OT or risk-taking because of these types of emotions, there is research that shows that individuals who experienced perceived prejudice reported feeling more angry, having more physical symptoms related to anger, and taking more risks on a computerized card task than individuals who did not experience perceived prejudice (Jamieson et al., 2013). Because there is currently no research that has explored the differential effects of

anger and experiences of prejudice on risk-taking, it is possible that experiencing negative emotions during data collection could have impacted style of risk-taking among participants. Finally, for some participants, data was collected in an individual session with a research assistant, while other participants completed study measures in groups of two to four. Although data collection took place in a private room and measures were taken to ensure that participants could not see each other's answers to sensitive questions, it is possible that some individuals felt uncomfortable reporting on sensitive topics with other people in the room. This could have resulted in underreporting of experiences of maltreatment.

Although the measures used in this study have been researched over time, each measure comes with its own unique limitations. The present study utilized the IGT as a measure of risk-taking; however, in past research it has also been used to measure of executive function (Verdejo-García, López-Torrecillas, Calandre, Delgado-Rodríguez, & Bechara, 2009), reward sensitivity (Balconi, Finocchiaro, & Canavesio, 2015), and impulsivity (Burdick et al., 2013). There are also many other biological variables, social variables, and personality traits identified throughout the literature that influence performance on the IGT, including testosterone (Stanton, Liening, & Schultheiss, 2011), negative affect, behavior activation in response to cues of reinforcement (Suhr & Tsanadis, 2007), handedness (Singh, 2016), anxiety (Miu, Heilman, & Houser, 2008), and sex (van den Bos, Homberg, & de Visser, 2013). Additionally, Wood and colleagues (2005) found that adults demonstrate different strengths in decision making on the IGT based on age; younger adults (ages 18-34) have better learning and memory, while older adults (ages 65-88) allow both wins and losses to influence their performance on the IGT. Young adults tend to allow losses on the IGT to influence their performance more, which can be detrimental. Because the present study includes a sample of individuals from a wide age range

(18 – 28) this should be considered in interpreting the results; it is possible that strengths and weaknesses may exist between subsets of younger adults (i.e. 18 – 23 vs. 24-29).

The use of the CTQ as a measure of childhood maltreatment comes with limitations due to the fact that it is a retrospective measure of childhood maltreatment. Hardt and Rutter (2004) conducted a review of the literature regarding the validity of retrospective measures of childhood maltreatment and reported that these types of measures often result in false negatives (individuals stating that they were not abused when they were), although false positives appeared to be rare. This is problematic because if there was underreporting among some participants, cut off scores defined within the CTQ manual were used to categorize participants as experiencing no abuse, mild abuse, moderate abuse, or severe abuse (Berstein & Fink, 1998). Underreporting could have led to individuals being categorized incorrectly, or in some individuals being excluded from the study when they had in fact, suffered from maltreatment as a child. This could have skewed the findings of this study; it may have been more beneficial for the present study to have a control group of individuals who reported no maltreatment, and to compare these individuals to people who endorsed some type of maltreatment regardless of the level of reported severity.

Although there is a lot of research to support the relationship between maltreatment and OT, it is important to look at other factors that can influence OT levels as a limitation to this study. For example, in a study in which a small sample of participants (n=23) gave two saliva samples; salivary OT levels increased significantly ($p=.0007$) from their baseline levels after listening to twenty minutes of relaxing music (Ooishi, Mukai, Watanabe, Kawato, & Kashino, 2017). Furthermore, increases of salivary OT have shown significant increases after engaging in different activities: running, sexual self-stimulation, and a social stress test (Jong et al., 2015).

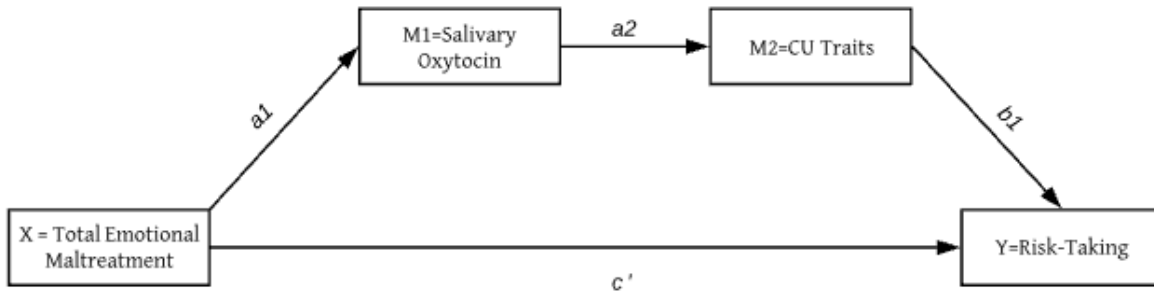
These findings are important because it demonstrates that there could be many confounding variables that could impact salivary OT depending on the types of activities that an individual engaged in prior to giving a saliva sample for analysis.

Future Directions for Research

Next steps for research about the relationship between childhood maltreatment, OT, and negative outcomes of survivors could go in several different directions. One way would be to explore how different traits that are related to risk-taking such as impulsivity, extraversion, psychoticism (Zuckerman & Kuhlman, 2000; Eysenck, 1976), risk and reward sensitivity (Gray, 1970), and sensation-seeking (Zuckerman, 1994a), may vary depending upon past maltreatment and OT levels. Additionally, exploration into predictors of risk-taking or differences in risk-taking that are motivated by gains vs. loss may be another interesting way to conceptualize a research question.

Another way to proceed with future research could be to delve further into the relationship that has been identified between callous and unemotional (CU) and overall risk-taking, as well as the relationship that has been found to exist between CU traits, and OT levels. Previous research has demonstrated that adolescents who score high on measures of callous and unemotional (CU) traits also engage in more risk-taking (Centifanti & Modecki, 2013). Scott (2017) also found that OT and CU traits serially mediated the relationship between childhood maltreatment and proactive aggression. Given these findings, it would be advantageous to explore the possibility of OT and CU traits as serial mediators in the relationship between childhood maltreatment and overall risk-taking. It would also be beneficial to obtain several measures of risk-taking (i.e. BART, self-report measure, other rated scale) to explore correlations between measures. A diagram of the proposed serial mediation model is displayed in Figure 5.

Figure 5. Proposed Serial Mediation Model



Finally, because there are differences in risk-taking that correlate with biological sex and age, future research could benefit from exploring a moderated mediation analysis in which gender or age acts as a moderator. Another way to explore this question could be by designing a study that compares participants across age and biological sex. These differences are important to explore given that adolescent boys may experience more severe outcomes than adolescent girls for risky or impulsive behavior (Garnefski & Diekstra, 1997). Additionally, male survivors of maltreatment engage in more risky behaviors, criminal behaviors, and suicide attempts than women who have experienced maltreatment as children. It is possible that the impact of maltreatment is more severe for males, given the unique challenges that men and boys face in disclosing experiences of maltreatment (Sorsoli et al., 2008). Additionally, exploring the differential impact of abuse experienced by adolescents and young adults may support young people in altering the course of trajectories that can lead to life-long illness, disability, or premature death.

Conclusion

This study builds upon the literature that seeks to understand the complex relationship between childhood maltreatment and adverse outcomes later in life. Although OT was not

identified as a mediator within the relationship between risk-taking and maltreatment, it was confirmed that experiences of maltreatment in childhood have a direct effect on salivary OT levels. Additionally, emotional maltreatment predicted risk-taking on the IGT when not controlling for OT. These findings imply that there is more to explore within this line of research, especially regarding how the alteration of OT levels among individuals who were maltreated in childhood contributes to the profound psychological, physical, and social impact of maltreatment. It is possible that the hypothesis of the present study was overly straightforward given the complex nature of abuse and human responses to trauma. Conclusively, these findings can be used to encourage other researchers to keep the limitations of the study in mind, and to approach future research with a sense of humility and inquisitiveness. The answer may not be simple, straightforward, or easy to find, but it is well worth the fight.

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