Examining the Link Between Emotional Childhood Abuse and

Social Relationships in Midlife:

The Moderating Role of the Oxytocin Receptor Gene

by

Ashley Marie Ebbert

A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Arts

Approved August 2018 by the
Graduate Supervisory Committee:

Frank Infurna, Chair
William Corbin
Kathryn Lemery
Suniya Luthar

ARIZONA STATE UNIVERSITY

August 2018

ABSTRACT

The current study examined the unique influence of emotional childhood abuse on positive and negative aspects of different types of social relationships (e.g., family, spouse/partner, and friends) in midlife and whether genetic variations of the oxytocin receptor gene (OXTR) moderated these associations. Genetic variations in OXTR are measured by single-nucleotide polymorphisms (SNPs), which have been the most substantially studied prospects for explaining individual differences in socio-behavioral phenotypes. Specifically, an SNP, rs53576, involving a guanine (G) to adenine (A) substitution located in the third intron of the OXTR has been associated with fundamental aspects of social processes and behaviors. Compared to A carriers, individuals homozygous for the G allele have enhanced social competencies and tend to elicit more positive responses from social partners, consequently increasing the overall quality of social relationships across the lifespan. However, the G allele of the OXTR has also been associated with greater social sensitivity. In the current study, conducted among a sample of 614 adults in midlife, it was shown that emotional childhood abuse was significantly associated with having less supportive and more strained relationships in midlife. Regarding supportive family relationships, the effect of emotional childhood abuse was moderated by the OXTR rs53576 polymorphism. Specifically, under conditions of more emotional abuse in childhood, individuals homozygous for the G allele had more supportive family relationships in midlife compared to A carriers. Overall, the findings suggest that genetic variations of OXTR rs53576 may be an important candidate in understanding the development of social relationship functioning within the context of negative early life experiences.

i

DEDICATION

To Wolfgang, for spending countless hours by my side and supporting me throughout my entire graduate experience, so far. Thank you for reminding me when to take breaks, for teaching me how to keep things in perspective, and for showing me the true meaning of unconditional love.

TABLE OF CONTENTS

iii

LIST OF TABLES

LIST OF FIGURES

Introduction

Childhood experiences play a fundamental role in shaping developmental outcomes across the lifespan (Baltes, 1987; Pruchno, Wilson-Genderson, & Cartwright, 2010). Negative childhood experiences have embedded and enduring effects that reach beyond childhood and adolescence and into adulthood and old age (e.g., Miller, Chen, & Parker, 2011; Repetti, Taylor, & Seeman, 2002). Numerous studies have shown that negative childhood experiences, marked by emotional childhood abuse, are associated with various outcomes in adulthood and old age, including lower levels of well-being (Whitelock, Lamb, & Rentfrow, 2013), greater psychological distress (Caspi et al., 2003; Cloitre et al., 2009), early onset of disease (Power, Kuh, & Morton, 2013), and early mortality (Brown et al., 2009; Chen, Turiano, Mroczek, & Miller, 2016). Beyond domains of mental and physical health, research has shown that emotional childhood abuse has persistent and extended consequences on social functioning in adulthood and old age (Schafer, Morton, & Ferraro, 2017).

An abundance of research suggests that social relationships may provide a secure foundation for optimal development and successful navigation of life's (inevitable) challenges (Antonucci, 2001; Luthar, Crossman, & Small, 2015). Individuals with strong social support networks, including spouses, friends, and family members, have better mental and physical health outcomes than those who do not have as many social resources (Antonucci, 2001; Holt-Lunstad, Smith, & Layton, 2010; Leavy, 1983; Uchino, 2009). Supportive relationships with spouses, friends, and family members are especially important because of their close and ongoing nature (Thoits, 2011; Walen & Lachman, 2000). The quality of these close relationships, in particular, can have significant

1

influences on health and longevity over time (Thoits, 2011; Umberson, Williams, Thomas, Liu, & Thomeer, 2014). For example, strong and supportive relationships, characteristic of mutual affect and affirmation, can have positive and beneficial effects on health and well-being by acting as a buffer to the negative effects of stressful events (Cacioppo & Cacioppo, 2014; Cohen & Wills, 1985). Conversely, unhealthy relationships may have harmful, compounding effects on mental and physical health (Warner & Hayward, 2006; Miller et al., 2011).

Although there is empirical evidence linking exposure to emotional childhood abuse with problematic outcomes across a variety of developmental domains (Luthar, 2003; Masten & Cicchetti, 2010; Berzenski & Yates, 2010), not all individuals with a history of childhood abuse suffer from deficits in social functioning in adulthood (Doucet & Aseltine, 2003). Many individuals manage to achieve high levels of social competence and emotional health despite the major stresses afforded by their abusive childhood experiences (McGloin & Widom, 2001). However, relatively little is known about potential moderators that may increase or decrease one's vulnerability to the negative effects of emotional childhood abuse on ensuing social development (Nielsen & Mather, 2011). In particular, the moderating role of genetic factors may provide a deeper understanding of how emotional childhood abuse may differentially affect social relationships in midlife. The gene coding for the oxytocin receptor (*OXTR*) has been found to have broad associations with social and emotional processing (Rodrigues, Saslow, Garcia, John, & Keltner, 2009) and may be instrumental in understanding the genetic contribution underlying individual differences in the impact of emotional childhood abuse on social relationships in midlife (Donaldson & Young, 2008).

Given the consequences of emotional childhood abuse on social functioning and relationships throughout development, the goals of the present study are twofold: (1) examine whether emotional childhood abuse is associated with positive and negative aspects of social relationships in midlife across different sources of social support (spouse/partner, friends, and family); (2) examine whether the oxytocin receptor gene moderates the link among emotional childhood abuse and various social relationships in midlife.

Linking Emotional Childhood Abuse to Social Functioning in Midlife

Exposure to emotional childhood abuse may lead to a wide array of interpersonal problems and interpersonal sensitivities (for a review, see Lamphear, 1985). For example, numerous studies have demonstrated that a history of emotional childhood abuse is related to the development of depression (Wise, Zierier, Krieger, & Harlow, 2001), anxiety (MacMillan et al., 2001), drug and alcohol dependency (Downs & Harrison, 1998; Shin, Miller, & Teicher, 2013), personality disorders (Horwitz, Widom, McLaughlin, & White, 2001), and generalized distress (Springer, Sheridan, Kuo, & Carnes, 2007). Additionally, emotional childhood abuse is often associated with an increased risk for developing social and emotional problems (e.g., Rogosch, Dackis, & Cicchetti, 2011). These negative experiences may distort how individuals process emotional information to guide their social behavior and form social relationships (e.g., Antonucci, 1990; Parrott & Bengtson, 1999), which may compromise the quality of their close relationships throughout development (Doyle, 2001; Rogosch, Cicchetti, & Aber, 1995). Specifically, studies have found that individuals with histories of emotional childhood abuse have fewer social competencies, lack the ability to navigate social

3

interactions and relationships, and adopt negative outlook on close relationships (e.g., Germine, Dunn, McLaughlin, & Smoller, 2015). However, even though exposure to emotional childhood abuse is undoubtedly one of the most stressful experiences, not all rough beginnings lead to problematic futures. In the face of childhood abuse, individuals' ability to adapt is varied, with some being able to maintain psychological and social functioning (see Luthar, Cicchetti, & Becker, 2000), whereas others may show initial declines, followed by gradual improvements (Infurna & Luthar, 2016).

Social relationships are multidimensional in that they consist of both positive (i.e., supportive) and negative (i.e., strained) qualities (Schuster, Kessler, and Aseltine, 1990). Supportive relationship features include caring, open, respectful, whereas strained relationship attributes are defined by criticism, demands, and misunderstanding. Social network properties have often been characterized by the number of members in an individual's social group, the duration of the relationships, and the proportion of relationships that are support-giving and support-receiving. Across the numerous conceptual models of social support, researchers have used numerous terms for categorizing social network properties. House and colleagues (1988) discuss network properties in terms of integration, structure, and relational content (House, Umberson, & Landis, 1988), whereas Antonucci and colleagues rely on broader terminology to describe the different types of support (e.g., emotional, instrumental, and informational) and the frequency of contact (Antonucci, 2001).

The perception and evaluation of social relationship quality depends on the source of support (e.g., family, spouse/partner, or friends; Antonucci, 2001). Spousal relationships are typically considered instrumental sources of emotional support whereas

friendships are generally considered sources of positive feedback and mutual appreciation (Lansford, 2000). Further, relationships that are the most salient and intimate may be impacted the most by external factors. Thus, it is important to disaggregate social networks and examine support and strain from different relationship domains. The present study focuses on both the positive and negative sides of social exchanges among unique relationship sources (e.g., family, spouse/partner, and friends).

Genetic Pathways Moderating the Link between Emotional Childhood Abuse and Social Relationships

Despite the well-established connection between exposure to emotional childhood abuse and the emergence of diverse outcomes for social development (Anda et al., 2006), little is known regarding the genetic pathways that may differentially influence individual responses to environmental stressors. Research on Gene-Environment (G x E) interactions has demonstrated that genetic variations may contribute to differential risk for negative outcomes under environmental conditions of adversity (Clifford & Lemery-Chalfant, 2015). Childhood abuse is an objectively measured, well-defined stressor that may interact with genetic factors to differentially shape the course of development (see Karg, Burmeister, Shedden, & Sen, 2011). Although a majority of G X E interaction studies have looked at the environmental effects on genetics (e.g., Caspi et al., 2002, 2003), recent evidence suggests that the inherent stability and individual nature of genes supports exploring the moderating role of genetics on the environment (Burmeister, McInnis, & Zollner, 2008). Genetic variations may influence the degree of individual sensitivity to environmental risk factors (e.g., childhood abuse) (Belsky & Pluess, 2009; Caspi et al., 2002, 2003).

The most prominent G x E model is the diathesis-stress model (see Zuckerman, 1999). This model postulates that an individual may be genetically susceptible to the adverse effects of environmental stressors through certain genetic propensities that may strengthen or weaken the negative effects of childhood abuse on the quality of social relationships in midlife (Ellis et al., 2011). My focus is on whether the oxytocin receptor gene moderates the association between emotional childhood abuse and multiple facets of social relationship quality. Recent studies investigating the genetic underpinnings of complex social behavior have found that oxytocin encourages prosocial behavior (for review, see Campbell, 2010) including affiliation (Neumann, 2002), generosity (Zak, Stanton, & Ahmadi), trust (Kosfeld, Heinrichs, Zak, Fischbacher, & Fehr, 2005), emotion recognition (Guastella, Mitchell, & Dadds, 2008), inferring the affective mental states of others (Domes et al., 2007) and positive communication (Ditzen et al., 2009).

Sociobehavioral Aspects of Oxytocin. Oxytocin is a neuropeptide that plays a critical role in regulating complex social behavior (Bartz, Zaki, Bolger, & Ochsner, 2011; Donaldson & Young, 2008; Heinrichs & Domes, 2008; Kumsta & Heinrichs, 2013) and encoding information relevant to social interactions (Meyer-Lindenberg, Domes, Kirsch, & Heinrichs, 2011). Functioning as both a neurotransmitter and a hormone (Gimpl & Fahrenholz, 2001), oxytocin's involvement spans a variety of physiological and neural processes related to social behavior (e.g., McQuaid, McInnis, Stead, Matheson, & Anisman, 2013). Specifically, oxytocin reduces social stress reactivity (Bartz & Hollander, 2006; Chen et al., 2011) and dampens physiological stress responses following distress (e.g., decreases cortisol levels; for review, see Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003). Oxytocin also enhances the reward of social encounters

(Heinrichs, Dawans, & Domes, 2009) and increases the motivation to engage more frequently in social interactions (Insel & Young, 2001). Although the exact understanding of the central effects of the oxytocin system remains unclear, it is possible to generally examine variability in oxytocin function by examining individual differences in the gene coding for the oxytocin receptor (*OXTR*) (Meyer-Lindenberg et al., 2011). Given the known heritability of sociality in humans (e.g., Knafo & Plomin, 2006; Scourfield, Martin, Lewis, & McGuffin, 1999), *OXTR* variations may explain how social behaviors differ across individuals and could play an instrumental role in moderating the effects of childhood abuse on multiple facets of social relationship quality.

Oxytocin Receptor Gene (*OXTR*) and Social Behavior. Recent studies have investigated the genetic mechanisms underlying individual differences in social neuropeptide signaling. In particular, genetic studies have focused on variations in the gene coding for the *OXTR* to examine individual differences in social behavior (McQuaid et al., 2013). The human genotype contains a single oxytocin receptor gene, located on chromosome 3p25 (Gimpl & Fahrenholz, 2001; Inoue et al., 1994), which encodes oxytocin receptors found in various brain regions (e.g., limbic structures, amygdala, hippocampus) associated with regulating cognitive and emotional aspects of complex social behavior and physiological responses to social stress (Gimpl & Farenholz, 2001; Landgraf & Neumann, 2004; Rodrigues et al., 2009). Genetic variations in *OXTR* are measured by single-nucleotide polymorphisms (SNPs), which have been the most substantially studied prospects for explaining individual differences in sociobehavioral phenotypes (see McQuaid, et al., 2013).

Existing research has identified a single intronic *OXTR* SNP, *rs53576* (G/A), commonly studied within the context of key social processes and behaviors (Donaldson & Young, 2008; Meyer-Lindenberg et al., 2011). Recent studies have found a significant association between *OXTR rs53576* and a variety of prosocial behaviors (Hammock & Levitt, 2006; Kumsta & Heinrichs, 2013) that may enhance social competency, elicit more positive responses from social partners, and consequently, increase the overall quality of social relationships across the lifespan (Robins, Caspi, & Moffit, 2002; Walum et al., 2012). Specifically, many studies have found that having one or two copies of the G allele was associated with several positive aspects of social functioning, including higher levels of empathy (Rodrigues et al., 2009), positive affect (Lucht et al., 2009), sensitivity to social support (Chen et al., 2011), and nonverbal displays of prosociality (Kogan et al., 2011). Furthermore, studies examining individuals homozygous for the G allele compared to those with the AG or AA genotypes found that GG carriers had higher levels of self-esteem and optimism (Saphire-Bernstein, Way, Kim, Sherman, & Taylor, 2011) and exhibited higher trust-related behaviors (Krueger et al., 2012). Together, these studies suggest that G allele carriers may have a greater inclination for engaging in adaptive social behaviors.

Further association studies suggest that genetic variations within *OXTR rs53576* are related to relationship quality (Bakermans-Kranenburg & van IJzendoorn, 2008) and may exhibit unique influences on different types of social relationships such as parent-child bonding behaviors (Feldman, Weller, Zagoory-Sharon, & Levine, 2007), feelings of romantic love and trust (Gonzaga, Turner, Keltner, Campos, & Altemus, 2006), and empathy and generosity toward strangers (Barraza & Zak, 2009). For example, one study

showed that mothers who carried at least one *OXTR rs53576* A allele appeared to be less socially inclined within the context of parenting and displayed lower parental sensitivity and responsiveness (Bakermans-Kranenburg & van IJzendoorn, 2008). Another study found a positive association between the rs53576 polymorphism and general sociality (i.e., how individuals respond to other people in general) but did not detect a significant association for close relationships (parent-child or romantic relationship) (Li et al., 2015). In particular, individuals homozygous for the G allele (GG) compared to A allele carriers (AA/AG) had higher levels of general sociality but interestingly, genotype did not influence close connections (Li et al., 2015). These results suggest that this SNP, in particular, predicts how individuals may typically respond to other people but cannot detect individual differences in close relationships.

Gene-Environment Interaction of *OXTR* and Social Relationships

Recent studies examining individuals ranging from childhood to midlife have provided evidence for a gene-environment interaction involving *OXTR rs53576* and childhood abuse (Heim et al., 2009; Fries et al., 2005; Smearman et al., 2016). When exploring the moderating effects of the *OXTR rs53576* genotype on the link between childhood abuse and psychological outcomes, not all research supports that G carriers (GG/GA) are more socially adjusted (Cornelis et al., 2012). Many studies do not support the interpretation that A carriers are vulnerable to disturbances in social functioning (e.g., Bradley et al., 2011). In fact, recent studies have demonstrated that the *rs53576* GG genotype is more susceptible to negative early life experiences (McQuaid et al., 2013; Bradley et al., 2011). For example, individuals who have at least one G allele and a history of childhood maltreatment were at an increased risk for developing emotional

dysregulation (Hostinar et al., 2014) and depression (McQuaid et al., 2013) compared to those homozygous for the A allele. Among individuals exposed to childhood abuse, GG carriers reported higher levels of adult separation anxiety (Costa et al., 2009) and greater disorganized attachment styles (Bradley et al., 2011). Another study examining sensitivity to social context in a sample of adolescents who reported maltreatment found that the GG genotype was significantly associated with feeling less supported compared to A allele carriers (Hostinar et al., 2014). Interestingly, G allele carriers benefit more from social support and show decreases in physiological responses to stress after receiving support (Chen et al., 2011). Under distressing circumstances, G allele carriers are more like to seek emotional support compared to A allele carriers (Kim et al., 2010). When exposed to early negative environments that lack support, the tendency to seek out social support among G carriers may lead to further distress and confusion about social relationships and undermine the quality of social relationships.

Genetic variation within *OXTR rs53576* is associated with several key constructs relevant to childhood maltreatment (e.g., attachment, social behavior, emotion regulation) and may confer susceptibility to problematic social development (Bradley, Davis, Wingo, et al., 2013; Bradley et al., 2011). These studies suggest that *OXTR rs53576* may moderate the vulnerability to early negative environments and account for the individual differences underlying the effects of childhood abuse on social relationship quality in midlife (Bartz et al., 2011; Karg et al., 2011; Kumsta & Heinrichs, 2013). Central to the diathesis-stress model, G carriers who are more socially attuned may actually be at a heightened risk for impaired social functioning when they encounter childhood abuse,

whereas A carriers may be protected by their lack of social sensitivity when exposed to the same adversity (e.g., Burmeister, McInnis, & Zollner, 2008).

The Present Study

Negative early life experiences (e.g., emotional childhood abuse) have enduring consequences on social relationships, which play a significant role throughout the lifelong process of development (Baumeister & Leary, 1995). Supportive relationships can act as a buffer against the negative effects of environmental stressors and have important implications for health and well-being (Poulin & Holman, 2013; Thoits, 2011). *OXTR*'s strong associations with stress reactivity and social behavior phenotypes make it a possible mechanism for understanding the link between emotional childhood abuse and social relationships in midlife (Hostinar et al., 2014; Tost et al., 2010).

The current study examines whether emotional childhood abuse influences positive and negative aspects of social relationships in midlife. Furthermore, the present study will focus on the *OXTR rs53576* genotype to test whether this particular polymorphism moderates the effects of emotional childhood abuse on perceived social support and social strain from various relationship sources (e.g., spouse/partner, friends, and family) in midlife. We hypothesized that emotional childhood abuse would be associated with reporting lower levels of social support and higher levels of social strain across each relationship domain. We hypothesized that genetic variations of *OXTR rs53576* will be related to specific sources of social support and social strain. Furthermore, there is evidence to support that genetic variations of *OXTR rs53576* influence sensitivity to social context (Kumsta & Heinrichs, 2013). As a result, we predict that G allele carriers will show an increased sensitivity to the negative effects of

11

emotional childhood abuse on social relationship quality in midlife compared to A allele carriers. Individuals carrying minor alleles (AA or AG) will not be as negatively influenced by childhood abuse due to these individuals being less sensitive to their social environments.

Method

Participants and Procedure

The present study used data from the AS U Live Project, which is a large-scale study of residents from the Phoenix metro area in midlife (aged 40-65) focusing on identifying individual, familial and social factors in resilience (Resilience Process in Individuals and Communities: R01 AG26006). A total of 800 study participants was recruited for the study, with a final number of 613 participating in the portion of the study that involved answering self-report questionnaires and providing blood samples for DNA genotyping. Participants completed self-report questionnaires about early family life and stressful events, as well as reported on the current quality of social relationships among friends, family members, and romantic partners. On average, participants were 54 years of age ($SD = 7.20$, range 40-65), 52% were women, 73% had a spouse or partner with an average relationship length of 20 years ($SD = 12.68$, range one month-55 years), 71.6% were white, and 50% attended some college.

Sampling and Recruitment. As described in full detail previously (Infurna, Rivers, Reich, & Zautra, 2015), a purposive sampling strategy was used to recruit 800 participants from 40 census tracts across the metropolitan Phoenix area between the years of 2007 and 2012. This method increased the external validity of research findings through representativeness of individuals, environment, and measured outcomes. Prior to

participation, participants gave informed consent. Participants were compensated for completion of self-report questionnaires and for providing blood samples. Inclusion criteria for recruitment were: (1) participant presently between the ages of 40 and 65 years, and (2) either English or Spanish speaking. Exclusionary criteria were: presence of physical, psychiatric, or cognitive impairments during initial recruitment contact, as measured by the Mental Status Questionnaire (Kahn & Miller, 1978). Attempts were made to keep balance between genders. The study was approved by the Arizona State University Institutional Review Board.

Genotyping for *OXTR rs53576*. Our sample was genotyped for genetic markers of interest, e.g., region from the Oxytocin Receptor Gene (*OXTR rs53576*). During a home health visit, whole blood samples for genotyping were collected, and DNA extraction, quantification, normalization, and amplification was done at the University of Wisconsin—Madison Biotechnology Sequencing Center. Strict quality control procedures were applied, ensuring the exclusion of duplication errors, Mendelian errors, missing call rates, gender and chromosomal anomalies, Hardy-Weinberg disequilibrium, and hidden relatedness. Due to genetic admixture possibly confounding results of an association if genetic variants are overrepresented in some ethnic subgroups and also overrepresented in people with high or low phenotypic scores (Choudhry et al., 2006; Shtir et al., 2009), analyses testing genetic moderation will include ethnicity as a covariate.

The allele distribution of *OXTR rs53576* was 279 GG individuals (128 male, 151 female) and 265 AG (133 male, 132 female) and 69 AA individuals (36 male, 33 female). For allele and genotype frequency distributions of *OXTR rs53576* in the American

population, one study found that the G allele frequency was 0.657 and the A allele frequency was 0.343, and the AA frequency was 0.116, the AG frequency was 0.453, and the GG frequency was 0.431 (Butovskaya et al., 2016).

Previous studies have coded *OXTR rs53576* as a two-level variable, either as an A carrier (AA/AG and GG) or G carrier (AA and AG/GG) model. Recent studies have shown that individuals carrying one or both copies of the rs53576 G allele, compared to those carrying both copies of the A allele, appeared to be more sensitive to their developmental environments (Bradley et al., 2011; McQuaid et al., 2013), more dependent on emotional social support (Kim et al., 2010), and more responsive to social support (Chen et al., 2011). However, studies have also used alternative grouping strategies, comparing GG carriers to individuals having one or both copies of the minor rs53576 A allele (GG vs. AA and AG) (Poulin et al., 2012; Rodrigues et al., 2009; Saphire-Bernstein et al., 2011; Tost et al., 2010). Based on mixed findings, we coded *OXTR rs53576* as a three-level (AA, AG, GG) genotypic model and re-ran significant interactions with *OXTR rs53576* coded as a two-level variable, both as an A carrier (AA/AG and GG) and G carrier (AA and AG/GG) model.

Measures

Emotional childhood abuse. We used the short-form of the childhood trauma questionnaire (CTQ) to assess the degree to which individuals experienced emotional abuse in childhood (Bernstein, Stein, Newcomb, Walker, Pogge, Ahluvalia, et al., 2003). The CTQ is a retrospective report that measures the degree to which individuals experienced emotional ($M = 2.29$, $SD = 1.21$, range: 1.00-5.00; alpha $= 0.86$) abuse before the age of 18. Items were answered on a 5-point Likert scale, ranging from 1

14

(*never true*) to 5 (*very often true*). Using the stem question, "When I was growing up…," participants responded to a total of three items for emotional abuse, including, "People in my family called me things like, 'stupid,' 'lazy,' or 'ugly,'" "People in my family said hurtful or insulting things to me," and "I believe I was emotionally abused." Although the CTQ is a retrospective report, it has been used as a guideline in clinical populations for determining whether people experienced significant emotional abuse during childhood (Thombs et al., 2006). For emotional abuse, mean scores were calculated with higher scores indicating higher levels of emotional childhood abuse.

Indicators of social support and strain. Perceived social support and social strain from family (not including one's spouse or partner), spouse/partner, and friends were measured to differentiate positive (family *M* = 3.32, *SD* = 0.68, range: 1.00-4.00; spouse/partner *M* = 3.55, *SD* = 0.59, range: 1.00-4.00; friends *M* = 3.31, *SD* = 0.61, range: 1.00-4.00) and negative (family *M* = 2.21, *SD* = 0.66, range: 1.00-4.00; spouse/partner *M* = 2.19, *SD* = 0.65, range: 1.00-4.00; friends *M* = 1.77, *SD* = 0.52, range: 1.00-3.67) aspects of social relationship quality among discrete relationship-types (see Walen & Lackman, 2000). All items were answered on a 4-point Likert scale, ranging from 1 (*not at all*) to 4 (*a lot*). Indicators of positive relationship qualities were measured through 6 items for each relationship that read: (i) How much do they care about you? (ii) How much do they understand the way you feel about things? (iii) How much do they appreciate you? (iv) How much can you rely on them for help if you have a serious problem? (v) How much can you open up to them if you need to talk about your worries? and (vi) How much can you relax and be yourself around them? Indicators of negative relationship qualities were measured through 6 items for each relationship that

read: (i) How often do they make too many demands on you? (ii) How often do they make you feel tense? (iii) How often are they critical of your behavior? (iv) How often do they use you or take advantage of you? (v) How often do they break a promise of help, let you down, or neglect you? and (vi) How often do they provoke feelings of conflict and anger? Values of social support and social strain were independently averaged to capture perceptions of social relationship quality from each relationship domain with higher scores reflecting either higher support or higher strain.

Exploratory factor analysis. For each domain of family, spouse/partner, and friends, maximum likelihood factor analyses were conducted using promax rotation. Scree plots and eigenvalues were used to evaluate factor structure. Two factors (support and strain) were extracted for all three relationships based on scree plots, eigenvalues greater than one, and factor loadings ranging from .57 to .85 for family, .55 to .91 for spouse/partner, and .69 to .82 for friends. Table 1 shows the specific factor loadings for each relationship source. Cronbach's alphas were as follows: Family support (.91), Family strain (.86), Partner support (.88), Partner strain (.86), Friend support (.90), and Friend strain (.86).

Spouse/partner relationships. We used data from 450 participants who indicated that they had a spouse or partner at the time of the study. The average relationship length was 20 years, with relationship duration ranging from one month to 55 years ($M = 20.01$, $SD = 12.68$), with more than half of the sample having a relationship length of 20 years or more.

Covariates. Age, gender, ethnicity, education, and neuroticism were assessed and included in the regression model because of their known relationship to emotional

Table 1

Factor Loadings for Exploratory Factor Analysis with Promax Rotation of Social Support and Social Strain Items for Relationships with Family, Spouses/Partners, and Friends

Item	Family		Spouses/Partners[a]		Friends	
	Support	Strain	Support	Strain	Support	Strain
How much do they care about you?	.845	-.102	.913	-.187	.822	-.042
How much do they understand the way you feel about things?	.765	.053	.732	.054	.787	.026
How much do they appreciate you?	.778	.075	.708	.118	.805	-.013
How much can you rely on them for help if you have a serious problem?	.820	-.063	.837	-.044	.794	-.036
How much can you open up to them if you need to talk about your worries?	.798	.004	.720	.144	.794	.000
How much can you relax and be yourself around them?	.762	.004	.722	.024	.695	.053
How often do they make too many demands on you?[b]	-.330	.823	-.201	.824	-.121	.722
How often do they make you feel tense?[b]	.103	.759	.023	.777	-.004	.718
How often are they critical of your behavior?[b]	.189	.569	-.033	.708	-.045	.690
How often do they use you or take advantage of you?[b]	-.078	.780	.195	.602	.023	.803
How often do they break a promise of help, let you down, or neglect you?[b]	.163	.614	.258	.546	.111	.704
How often do they provoke feelings of conflict and anger?[b]	.175	.687	.096	.711	.059	.693

Note. N = 614. However, there is a variation in *sample size* for the spouse/partner items due to the variation in the number of participants with a spouse/partner.

[a] *n* = 450.

[b] Items were reverse scored.

childhood abuse and each facet of social relationships examined. Due to environmental effects being 30% heritable and the likelihood that people scoring high on neuroticism report more childhood abuse, we included neuroticism as a covariate. Neuroticism was assessed with items from the Big-Five Inventory (Goldberg, 1992), including depressed, relaxed, tense, worrying, emotionally stable, moody, calm, and nervous. Participants were asked how well each item described him/her in general on a 4-point scale (1 = *disagree strongly*; 5 = *agree strongly*). Internal consistency reliability for the current sample was .82.

Statistical Analyses

All data analyses were conducted using IBM SPSS Statistics software, version 25. We examined the distribution of all key predictor and outcome variables. As a result of the emotional childhood abuse variable being positively skewed, we assessed the normality of the distributions of residuals using Q-Q plots. However, the residual points on the Q-Q plots did not exhibit substantial discrepancy from the expected normal values.

Separate hierarchical multiple regression analyses were conducted in order to examine whether emotional childhood abuse predicted social support and social strain for each relationship source (e.g., family, spouse/partner, friends). Specifically, we examined whether emotional childhood abuse uniquely predicted positive and negative aspects of social relationship quality, after accounting for demographic variables of interest (e.g., age, gender, ethnicity, and education) and neuroticism. Further, we were interested in whether *OXTR rs53576* genotype moderated the association between emotional childhood abuse and social relationships. In each of the analyses, age, gender, ethnicity, education, and neuroticism were controlled for at the outset. Levels of neuroticism were

entered in the initial step in order to explore expectations that neuroticism may account for a significant proportion of variance when relating emotional childhood abuse to unique aspects of social functioning in midlife. Further, we were interested in whether main and interaction effects of the predictors of interest remained significant after including neuroticism as a predictor. Based on a lack of evidence to support main effects for *OXTR rs53576* genotype on aspects of social functioning, genotype variables were entered in Step 2, followed by emotional childhood abuse in Step 3, allowing for an evaluation of the unique explanatory power of emotional childhood abuse as predictors of both positive and negative aspects of relationship quality for distinct relationship sources.

In order to attain a more accurate understanding of how *OXTR rs53576* genotypes may moderate relations between emotional childhood abuse and social relationship quality, a two-way interaction term was considered in the final step. The two-way interaction term was entered as one of the last steps in order to determine their unique contribution to variance accounted for, after the main effects had already been entered.

As recommended by Aiken and West (1991), the predictors were centered prior to running the analyses, in order to aid in interpretation of the effects and avoid problems of multicollinearity. In order to aid in the interpretation of interaction effects, a graph was created for each significant interaction, with regression slopes depicting associations between the predictor (e.g., emotional childhood abuse) and the outcome (e.g., aspects of social relationships) at each genotype level (AA, AG, and GG) of the moderator (see Jaccard, Turrisi, & Wan, 1990). Figure 1 depicts the significant interaction from the main analysis.

For coding *OXTR rs53576*, a two-level variable was created as an A carrier (AA/AG and GG) model.

Results

Descriptive Statistics

Table 2 depicts the descriptive statistics and correlations for all variables examined within the regression models for the entire sample. The correlations from Table 2 suggest that neuroticism is significantly correlated with all childhood abuse variables (emotional: $r = .33$, $p < .05$; physical: $r = .14$, $p < .05$; sexual: $r = .13$, $p < .05$), as well as supportive and strained relationships among family (supportive: $r = -.28$, $p < .05$; strained: $r = .35$, $p < .05$), spouse/partner (supportive: $r = -.14$, $p < .05$; strained: $r = .24$, $p < .05$), and friends (supportive: $r = -.25$, $p < .05$; strained: $r = .33$, $p < .05$). Overall, neuroticism was significantly correlated with reporting higher levels of emotional childhood abuse, as well as less supportive and more strained relationships for all relationship sources. Outcome variables were also significantly correlated ranging from $r = .09$ ($p < .05$) to $r = .65$ ($p < .05$). However, as previously noted, exploratory factor analyses confirmed that support and strain outcomes measured two unique relationship dynamics. These findings highlight the importance of exploring the variance accounted for by current levels of self-reported neuroticism. Table 3 depicts the descriptive statistics and correlations for all variables examined within the regression models separately by gender.

OXTR rs53576 **genotype x childhood abuse interaction.** A one-way analysis of variance (ANOVA) was conducted to determine whether there were differences in levels of specific forms of childhood abuse by the three *OXTR rs53576* genotypes (AA, AG, and GG).

Table 2

Means, Standard Deviations, and Correlations Among All Variables

M	SD	Measure	1	2	3	4	5	6	7	8	9	10	11	12	13
53.61	(7.20)	**1. Age**	1.00												
0.48	(0.50)	**2. Gender** [b]	0.07	1.00											
0.72	(0.45)	**3. Ethnicity** [c]	0.19*	-0.06	1.00										
6.50	(1.74)	**4. Education**	0.13*	0.00	0.19*	1.00									
0.45	(0.50)	**5. OXTR rs53576 GG**	0.05	-0.03	-0.02	-0.02	1.00								
2.29	(1.21)	**6. Emotional Abuse**	-0.03	-0.15*	-0.11*	-0.02	-0.01	1.00							
3.32	(0.68)	**7. Family Support**	-0.05	0.08	0.07	0.05	-0.03	-0.31*	1.00						
2.21	(0.66)	**8. Family Strain**	-0.12*	-0.16*	-0.08	0.01	0.02	0.37*	-0.44*	1.00					
3.35	(0.59)	**9. Spouse Support** [a]	0.07	0.15*	0.17*	0.14*	-0.04	-0.14*	0.28*	-0.22*	1.00				
2.19	(0.65)	**10. Spouse Strain** [a]	-0.08	-0.10*	-0.11*	-0.05	0.02	0.19*	-0.20*	0.34*	-0.65*	1.00			
3.31	(0.61)	**11. Friend Support**	0.00	-0.15*	0.19*	-0.05	-0.08	-0.09*	0.25*	-0.09*	0.22*	-0.13*	1.00		
1.77	(0.52)	**12. Friend Strain**	-0.13*	0.02	-0.08	-0.05	0.03	0.20*	-0.13*	0.31*	-0.12*	0.22*	-0.33*	1.00	
21.42	(6.40)	**13. Neuroticism**	-0.07	-0.16*	-0.01	-0.02	-0.02	0.33*	-0.28*	0.35*	-0.25*	0.33*	-0.14*	0.24*	1.00

Note. $N = 614$. However, there is a variation in *sample size* for the spouse/partner variables.

[a] $n = 450$.

[b] Female = 0, Male = 1

[c] Other = 0, White = 1

*p < .05.

21

Table 3

Means, Standard Deviations, and Correlations by Gender (females = bottom in italics; males = top in bold)

M	SD	Measure	1	2	3	4	5	6	7	8	9	10	11	12
54.13	**(7.13)**	**1. Age**	**1.00**	**0.28***	**0.22***	**-0.02**	**-0.06**	**-0.10**	**-0.10**	**-0.01**	**-0.01**	**-0.01**	**-0.17***	**-0.03**
53.12	*(7.23)*													
0.69	**(0.46)**	**2. Ethnicity** [b]	*0.11**	**1.00**	**0.19***	**-0.01**	**-0.14***	**0.08**	**-0.09**	**0.14***	**-0.06**	**0.18***	**-0.07**	**-0.07**
0.74	*(0.44)*													
6.49	**(1.76)**	**3. Education**	*0.06*	*0.19**	**1.00**	**0.05**	**0.00**	**0.06**	**-0.05**	**-0.06**	**0.14***	**0.15***	**-0.07**	**-0.05**
6.50	*(1.72)*													
0.44	**(0.50)**	**4. OXTR rs53576 GG**	*0.11**	*-0.03*	*0.00*	**1.00**	**-0.07**	**-0.05**	**0.04**	**-0.05**	**-0.02**	**-0.09**	**0.11**	**-0.08**
0.47	*(0.50)*													
2.10	**(1.09)**	**5. Emotional Abuse**	*0.01*	*-0.11*	*-0.12**	*0.03*	**1.00**	**-0.25***	**0.31***	**-0.06**	**0.16**	**-0.12***	**0.20***	**0.33***
2.47	*(1.29)*													
3.26	**(0.72)**	**6. Family Support**	*0.01*	*0.05*	*0.12**	*-0.02*	*-0.39**	**1.00**	**-0.49***	**0.23***	**-0.17***	**0.29***	**-0.17***	**-0.29***
3.37	*(0.64)*													
2.10	**(0.62)**	**7. Family Strain**	*-0.12*	*-0.09*	*-0.07*	*0.00*	*0.39**	*-0.43**	**1.00**	**-0.18***	**0.28***	**-0.12***	**0.28***	**0.33***
2.30	*(0.68)*													
3.63	**(0.52)**	**8. Spouse Support** [a]	*0.10*	*0.24**	*0.16**	*-0.03*	*-0.17**	*0.39**	*-0.24**	**1.00**	**-0.55***	**0.26***	**-0.08**	**-0.16***
3.46	*(0.65)*													
2.13	**(0.60)**	**9. Spouse Strain** [a]	*-0.13*	*-0.18**	*-0.12*	*0.04*	*0.20**	*-0.26**	*0.38**	*-0.71**	**1.00**	**-0.13***	**0.18***	**0.29***
2.26	*(0.69)*													
3.22	**(0.61)**	**10. Friend Support**	*0.03*	*0.18**	*0.14**	*-0.07*	*-0.11*	*0.20**	*-0.12**	*0.25**	*-0.16**	**1.00**	**-0.34***	**-0.14***
3.40	*(0.60)*													
1.78	**(0.52)**	**11. Friend Strain**	*-0.09*	*-0.09*	*-0.04*	*-0.04*	*0.22**	*-0.10*	*0.35**	*-0.16**	*0.27**	*-0.32**	**1.00**	**0.22***
1.76	*(0.52)*													
20.35	**(6.34)**	**12. Neuroticism**	*-0.08*	*0.02*	*0.00*	*0.03*	*0.30**	*-0.31**	*0.33**	*-0.31**	*0.35**	*-.20**	*0.27**	**1.00**
22.40	*(6.30)*													

Note. N females = 321; N males = 292. However, there is a variation in sample size for the spouse/partner variables.
[a] *n females = 227; n males = 240.*
[b] Other = 0, White = 1

*p < .05.

The results from the ANOVA determined that there were no significant differences in reports of emotional childhood abuse across the *OXTR rs53576* genotypes [F (2, 601) = .106, p = .90]. Thus, these findings suggest that there is no evidence for a gene-environment correlation for histories of childhood abuse.

Emotional Childhood Abuse, *OXTR rs53576*, and Positive and Negative Aspects of Social Relationships

Controlling for demographic variables of interest, we used hierarchical regression analyses to test the main effects of emotional childhood abuse and moderation by *OXTR rs53576* genotype on positive and negative aspects of social relationships among all participants with data for each relationship domain (family *n* = 614; spouse/partner *n* = 450; friends *n* = 614). Results of hierarchical regression analyses are summarized in Tables 4, 5, and 6. For each step, the increments in R^2 change are indicated. The full models accounted for a substantial proportion of the variance for unique aspects of social relationships for different relationship sources (about 20% of the variance for family relationship outcomes and 10% of the variance for romantic relationship and friendship outcomes). In our main analyses, *OXTR rs53576* genotypes were represented by a two-level variable coded as an A carrier (AA/AG and GG) model.

     Perceptions of supportive and strained family relationships.

     Supportive family relationships. With regard to supportive family relationships, gender and age were unique demographic predictors once the emotional childhood abuse predictor was included in the model. Compared to females, males were more likely to perceive family relationships as being less supportive in midlife (β = -.15). Additionally, being older was significantly associated with perceiving family relationships as being less

supportive. As expected, higher levels of neuroticism were significantly associated with perceiving family relationships as being less supportive ($\beta = -.31$). Further, childhood emotional abuse was a significant predictor of perceiving less support from family relationships ($\beta = -.24$), after controlling for the effects of age, gender, ethnicity, education, neuroticism, and genotype. After controlling for demographic predictors and main effects of genotype and abuse variables, there was a significant 2-way interaction between *OXTR rs53576* GG genotype and emotional childhood abuse ($\beta = .16$). Compared to individuals with an A allele, individuals with a GG genotype who experienced higher levels of emotional childhood abuse were more likely to have more supportive family relationships in midlife (see Figure 1).
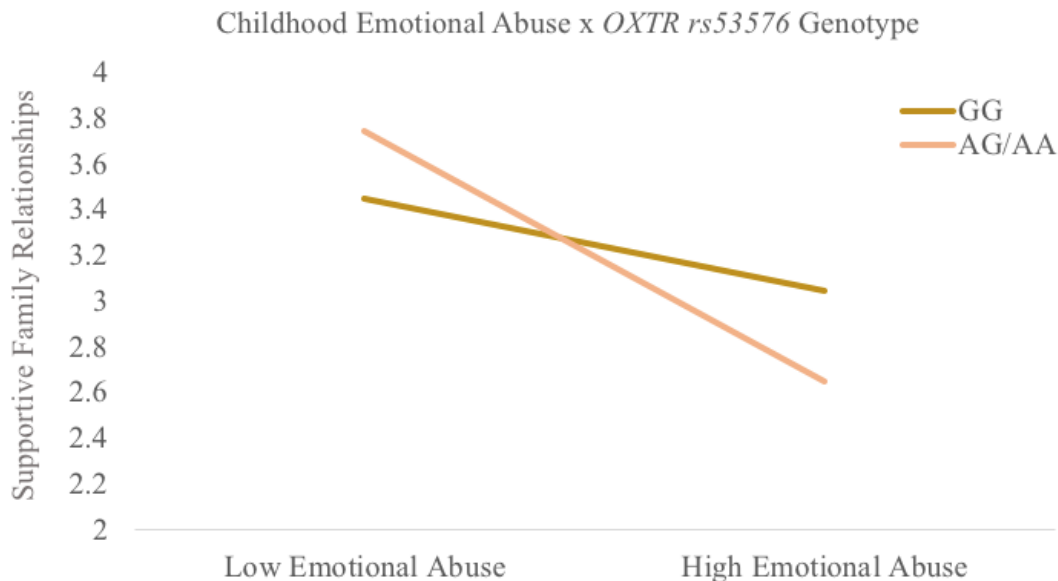

Fig 1. Illustrating the moderating effect of *OXTR rs53576* genotype on levels of emotional childhood abuse for ratings of supportive family relationships. Compared to participants with at least one A-allele, participants with GG genotypes were more likely to perceive their family relationships as being more supportive in the context of higher levels of emotional childhood abuse.

We see that stronger changes or steeper slopes in declining supportive relationships as a function of emotional childhood abuse is indicative of individuals carrying at least one minor allele (e.g., AG or AA) for the *OXTR rs53576* polymorphism. Our findings suggest that individuals having a GG genotype for the *OXTR rs53576* polymorphism may be less at risk for experiencing the negative consequences of emotional childhood abuse with regard to supportive family relationships in midlife. Table 4 depicts the predictors that uniquely contributed to supportive family relationships, having considered variance shared with all other predictors in the equation.

Strained family relationships. Regarding perceived strain from family relationships, age and gender were significant demographic predictors at each step of the analysis. As with supportive family relationships, males were more likely to perceive family relationships as being less strained in midlife. Being older was also significantly associated with perceiving family relationships as being less strained. Higher levels of neuroticism were significantly associated with perceiving family relationships as being more strained ($\beta = .32$). As expected, childhood emotional abuse was a significant predictor of perceiving family relationships as being more strained ($\beta = .28$), after controlling for the effects of age, gender, ethnicity, education, neuroticism, and genotype. After accounting for demographic predictors and main effects of genotype and abuse variables, there was no significant 2-way interaction between *OXTR rs53576* genotype and emotional childhood abuse. Table 4 depicts the predictors that uniquely contributed to strained family relationships, having considered variance shared with all other predictors in the equation.

25

Table 4

Examining the Moderating Effect of OXTR rs53576 Genotype on the Link Between Emotional Childhood Abuse and Family Relationships

Family Support Variables	Model 1			Model 2			Model 3			Model 4		
	Estimate	SE	β	Estimate	SE	β	Estimate	SE	β	Estimate	SE	β
Constant	3.32*	.03		3.32*	.03		3.32*	.03		3.32*	.03	
Age	-.01*	.004	-.08	-.01*	.004	-.08	-.01	.004	-.07	-.01*	.004	-.09
Gender [a]	-.16*	.05	-.12	-.16*	.05	-.12	-.20*	.05	-.15	-.19*	.05	-.14
Ethnicity [b]	.08	.06	.05	.08	.06	.05	.04	.06	.03	.04	.06	.03
Education	.03	.02	.07	.03	.02	.07	.02	.02	.06	.02	.02	.06
Neuroticism	-.03*	.004	-.31	-.03*	.004	-.31	-.03*	.004	-.24	-.03	.004	-.24
OXTR rs53576 GG				-.05	.05	-.04	-.05	.05	-.04	-.05	.05	-.04
Emotional Abuse							-.14*	.02	-.24	-.14*	.02	-.24
Emotional Abuse x GG										.18*	.04	.16
R²	.11			.11			.16			.19		
ΔR²	.11*			.001			.05*			.02*		

Family Strain Variables	Model 1			Model 2			Model 3			Model 4		
	Estimate	SE	β	Estimate	SE	β	Estimate	SE	β	Estimate	SE	β
Constant	2.20*	.03		2.20*	.03		2.20*	.02		2.20*	.02	
Age	-.01*	.004	-.01	-.01*	.004	-.09	-.01*	.003	-.10	-.01*	.003	-.10
Gender [a]	-.14*	.05	-.11	-.14*	.05	-.11	-.10	.05	-.07	-.10	.05	-.07
Ethnicity [b]	-.06	.06	-.04	-.06	.06	-.04	-.02	.06	-.01	-.02	.06	-.01
Education	-.01	.02	-.02	-.01	.02	-.02	-.004	.01	-.01	-.004	.01	-.01
Neuroticism	.03*	.004	.32	.03*	.004	.32	.02*	.004	.23	.02*	.004	.23
OXTR rs53576 GG				.04	.05	.03	.05	.05	.03	.04	.05	.03
Emotional Abuse							.15*	.02	.28	.15*	.02	.28
Emotional Abuse x GG										-.01	.04	-.01
R²	.14			.14			.21			.21		
ΔR²	.14*			.001			.07*			.00		

Note. N = 614.
[a] Female = 0; Male = 1
[b] Other = 0; White = 1
*p < .05

26

Perceptions of supportive and strained spouse/partner relationships.

Supportive spouse/partner relationships. With regard to romantic relationships, only ethnicity and gender were significant demographic predictors of supportive romantic relationships. At every step of the analysis, even after accounting for neuroticism, "being white" was associated with perceiving romantic relationships as being more supportive (β = .18). Similarly, compared to females, males were more likely to perceive romantic relationships as being more supportive in midlife (β = .14), even after accounting for all other demographic and predictor variables. As expected, higher levels of neuroticism were associated with perceiving romantic relationships as being less supportive (β = -.23). We did not find any significant main effects of childhood abuse on perceived levels of support for romantic relationships in midlife.

Strained spouse/partner relationships. For strained romantic relationships, ethnicity was the only significant demographic predictor of strained romantic relationships. Before accounting for childhood abuse predictors, "being white" was significantly associated with perceiving romantic relationships as being less strained (β = -.12). As expected, higher levels of neuroticism were associated with perceiving romantic relationships as being more strained in midlife (β = .32). After accounting for demographic predictors, neuroticism, and main and interaction effects, emotional childhood abuse was a significant predictor of perceiving romantic relationships as being more strained (β = .09). There were no significant interaction effects for strained romantic relationships. Table 5 depicts the predictors that uniquely contributed to supportive and strained spousal relationships, having considered variance shared with all other predictors in the equation.

27

Table 5

Examining the Moderating Effect of OXTR rs53576 Genotype on the Link Between Emotional Childhood Abuse and Spousal Relationships

	Model 1			Model 2			Model 3			Model 4		
Spouse/Partner Support Variables	Estimate	SE	β	Estimate	SE	β	Estimate	SE	β	Estimate	SE	β
Constant	3.55*	.02		3.55*	.03		3.55*	.03		3.55*	.03	
Age	.000	.004	-.002	.000	.004	-.002	.000	.004	-.002	.000	.004	-.002
Gender a	.16*	.05	.14	.16*	.05	.13	.15*	.05	.13	.15*	.05	.13
Ethnicity b	.24*	.06	.18	.23*	.06	.18	.23*	.06	.18	.28*	.06	.17
Education	-.01	.02	-.03	-.01	.02	-.03	-.01	.02	-.03	-.01	.02	-.03
Neuroticism	-.02*	.004	-.23	-.02*	.004	-.23	-.02*	.004	-.22	-.02*	.004	-.22
OXTR rs53576 GG				-.03	.05	-.03	-.04	.05	-.03	-.03	.05	-.03
Emotional Abuse							-.02	.02	-.04	-.02	.02	-.04
Emotional Abuse x GG										.04	.05	.04
R²	.11	.55		.11	.55		.11	.55		.11	.55	
ΔR²	.11*			.001			.001			.002		
Spouse/Partner Strain Variables												
Constant	2.20*	.03		2.20*	.03		2.20*	.03		2.20*	.03	
Age	-.004	.004	-.04	-.004	.004	-.04	-.003	.004	-.04	-.003	.004	-.04
Gender a	-.06	.06	-.05	-.05	.05	-.05	-.05	.06	-.04	-.05	.06	-.04
Ethnicity b	-.17*	.07	-.12	-.17*	.07	-.12	-.16*	.07	-.11	-.16*	.07	-.11
Education	.03	.02	.08	.03	.02	.08	.03	.02	.09	.03	.02	.09
Neuroticism	.03*	.01	.32	.03*	.01	.32	.03*	.01	.30	.03*	.01	.30
OXTR rs53576 GG				.03	.06	.02	.03	.06	.02	.03	.06	.02
Emotional Abuse							.05*	.03	.09	.05*	.03	.09
Emotional Abuse x GG										-.02	.05	-.02
R²	.13	.61		.13	.61		.14	.60		.14	.60	
ΔR²	.13*			.000			.01*			.000		

Note. N = 450.
a Female = 0; Male = 1
b Other = 0; White = 1
*p < .05

28

Perceptions of supportive and strained friendships.

Supportive friendships. With regard to perceptions of supportive friendships, education, ethnicity, and gender were significant predictors of perceiving friendships as being supportive in midlife. At every step of the analysis, being more educated, white, and female were significantly associated with perceiving friendships as being more supportive ($\beta = .12$, $\beta = .15$, and $\beta = -.17$, respectively). As expected, higher levels of neuroticism were associated with perceiving friendships as being less supportive ($\beta = -.16$). There were no significant main nor interaction effects for supportive friendships. Table 6 depicts the predictors that uniquely contributed to supportive friend relationships, having considered variance shared with all other predictors in the equation.

Strained friendships. Age was a significant demographic predictor of friendships being perceived as being more strained. Accounting for all other variables, being older was significantly associated with perceiving friendships as being less strained ($\beta = -.10$). Consistent with all prior analyses, neuroticism were significantly associated with perceived strain for friendships ($\beta = .20$). After controlling for neuroticism and other demographic variables of interest, emotional childhood abuse was a significant predictor of strained friendships ($\beta = .14$). After controlling for genotype and emotional abuse, gender was significantly associated with perceiving friendships as being more strained ($\beta = .08$), suggesting that females perceive friendships as being less strained. There were no significant interaction effects for strained friendships. Table 6 depicts the predictors that uniquely contributed to strained friend relationships, having considered variance shared with all other predictors in the equation.

29

Table 6

Examining the Moderating Effect of OXTR rs53576 Genotype on the Link Between Emotional Childhood Abuse and Friend Relationships

	Model 1			Model 2			Model 3			Model 4		
Friend Support	Estimate	SE	β	Estimate	SE	β	Estimate	SE	β	Estimate	SE	β
Variables												
Constant	3.32*	.02		3.32*	.02		3.32*	.02		3.32*	.02	
Age	-.01	.003	-.06	-.01	.003	-.05	-.01	.003	-.05	-.004	.003	-.05
Gender [a]	-.20*	.05	-.16	-.20*	.05	-.16	-.20*	.05	-.17	-.21*	.05	-.17
Ethnicity [b]	.22*	.06	.16	.21*	.06	.16	.21*	.06	.15	.21*	.06	.15
Education	.04*	.01	.12	.04*	.01	.12	.04*	.01	.12	.04*	.01	.12
Neuroticism	-.02*	.004	-.17	-.02*	.004	-.17	-.02*	.004	-.16	-.02*	.004	-.16
OXTR rs53576 GG				-.09	.05	-.07	-.09	.05	-.07	-.09	.05	-.07
Emotional Abuse							-.02	.02	-.04	-.02	.02	-.04
Emotional Abuse x GG										-.03	.04	-.03
R²	.09	.58		.10	.58		.10	.58		.10	.58	
ΔR²	.09*			.01			.001			.001		
Friend Strain												
Variables												
Constant	1.78*	.02		1.78*	.02		1.78*	.02		1.78*	.02	
Age	-.01*	.003	-.10	-.01*	.003	-.10	-.01*	.003	-.10	-.01*	.003	-.10
Gender [a]	.07	.04	.06	.07	.04	.06	.08*	.04	.08	.09*	.04	.08
Ethnicity [b]	-.06	.05	-.05	-.05	.05	-.05	-.04	.05	-.03	-.03	.05	-.03
Education	-.01	.01	-.02	-.01	.01	-.02	-.01	.01	-.02	-.01	.01	-.02
Neuroticism	.02*	.003	.25	.02*	.003	.25	.02*	.003	.21	.02*	.003	.20
OXTR rs53576 GG				.04	.04	.04	.04	.04	.04	.04	.04	.04
Emotional Abuse							.06*	.02	.14	.06*	.02	.14
Emotional Abuse x GG										.01	.03	.01
R²	.08	.50		.08	.50		.10	.50		.10	.50	
ΔR²	.08*			.001			.02*			.000		

Note. N = 614.

[a] Female = 0; Male = 1

[b] Other = 0; White = 1

*p < .05

30

<center>**Discussion**</center>

Given the importance of social relationships for positive physical, mental, and emotional health in midlife, the present study examined genetic variations of *OXTR rs53576* as one potential pathway linking emotional childhood abuse to perceived social support and social strain from various relationship sources (e.g., spouse/partner, family, and friends) in midlife. Based on the potential for genetic processes to motivate affiliative behaviors (DeWall, Deckman, Pond, & Bonser, 2011) and prior research implicating the role of the oxytocin system in close relationship processes across development (Donaldson & Young, 2008; Galbally et al., 2011), we were interested in understanding how *OXTR* may interact with emotional childhood abuse to predict social functioning in midlife. Many studies have found that the polymorphism *OXTR* rs53576 influences various aspects of social behavior (Domes et al., 2007; Heinrichs et al., 2003; Meyer-Lindenberg et al., 2008; Neumann, 2002). Similarly, we found that variations in *OXTR rs53576* genotype contributed to individual differences in response to histories of emotional childhood abuse and its influence on social functioning in midlife.

Emotional Childhood Abuse and Positive and Negative Aspects of Social Relationships

Our findings that emotional childhood abuse was associated with less supportive and more strained relationships, in general, is consistent with previous research findings that emotional childhood abuse can have profound influences on the quality of relationships throughout the course of development (e.g., Gregory, Caspi, Moffitt, & Poulton, 2006; Schafer, Ferraro, & Mustillo, 2011). For example, individuals with a history of emotional childhood abuse are at risk for exhibiting social delays (Kim &

<center>31</center>

Cicchetti, 2010), deficits in empathy (Beeghly & Cicchetti, 1994), impaired emotional

regulation (Repetti et al., 2002), and decreased engagement in prosocial behavior

(Koenig, Cicchetti, & Rogosch, 2004). These negative consequences have been found to

persist into adulthood (Young & Widom, 2014). For example, numerous studies have

found that adults who have been emotionally abused in childhood have been found to

develop detached familial relationships (Davey, Eggebeen, & Savla, 2007), interpersonal

difficulties (Johnson et al., 2002; Wilson et al., 2006), and marital problems (Waldinger,

Schulz, Barsky, & Ahern, 2006). Emotional childhood abuse may interfere with the

development of social skills in adulthood, which in turn was associated with having fewer

close relationships and feeling more emotionally isolated in adulthood (Wilson et al.,

2006).

Regarding familial relationships, we found that emotional childhood abuse had a

negative impact on supportive family relationships for adults in midlife, which is

consistent with previous research that has found that feelings of closeness to family were

compromised for individuals with emotional abuse (Savla et al., 2013). Regarding

relationships with spouses/partners, our findings that emotional abuse were associated

with perceiving romantic relationships as being more strained is consistent with previous

research on the development and maintenance of healthy intimate relationships in

adulthood for individuals who experienced childhood abuse and neglect (Colman &

Widom, 2004). These findings suggest that adults with histories of childhood abuse may

differ in both their tendency to become involved in intimate relationships and in the

overall quality of their romantic partnerships.

In general, for individuals with histories of emotional childhood abuse, negative early life experiences may have had a cumulative effect on the development of close, personal relationships by contributing to social and psychological distancing from close others later in life. Similarly, these individuals may have developed negative internal working models negatively impacting social functioning capabilities. It is also possible that they may have received, as well as perceived, less positive and supportive social interactions throughout their lives, making it more difficult in adulthood to foster more supportive and less strained connections. In sum, emotional childhood abuse may disrupt the normal process of social and emotional development, leading to deficits in social functioning in midlife.

Emotional Childhood Abuse, *OXTR* rs53576and Positive and Negative Aspects of Social Relationships

Our findings suggest that negative early life experiences may create vulnerabilities or interact with genetically based vulnerabilities that lead to disruptions in social functioning, such as emotion processing and social competence. Specifically, our results are in line with other studies finding that individuals who carry the *OXTR G* variant show advantages in psychological adjustment, processing of social information, trust behaviors, and creating supportive interpersonal contexts (Bakermans-Kranenburg & van IJzendoorn, 2008; Ebstein, Israel, Chew, Zhong, & Knafo, 2010). Regarding supportive family relationships, we found that those individuals homozygous for the G allele of *OXTR rs53576* who reported higher levels of emotional childhood abuse found family relationships to be more supportive in midlife. In general, within the context of

33

supportive family relationships in midlife, GG carriers seemed to be less negatively impacted by the consequences of emotional childhood abuse.

Regarding strained family relationships in midlife, our findings were mixed. Within the context of higher levels of emotional abuse, individuals having at least one A allele of *OXTR rs53576* found family relationships to be more strained in midlife. Similar to our findings on emotional abuse, Chen and colleagues (2011) found that genetic variation impacts the degree to which individuals benefit from social support with A carriers responding less favorably to support. *OXTR rs53576* may influence the effectiveness of social support by influencing the reward value of social interaction early in development, which may in turn influence the tendency to seek and benefit from social support. In another study, individuals with the *OXTR rs53576* GG allele showed higher levels of maternal sensitivity than AA and AG individuals, only in the absence of high levels of inter-parental conflict (Sturge-Apple, Cicchetti, Davies, & Suor, 2012). These findings suggest that GG carriers may not always benefit from their socially attuned attributes within different stressor environments. Although most studies have focused on genetic variations that confer risk in the context of emotional childhood abuse, an alternate perspective suggests that the inherited phenotype may represent the degree of individual sensitivity to the environmental context in response to environmental factors (Belsky et al., 2009). For example, one study found that G allele carriers are more sensitive to the environment whether it was positive or negative (McQuaid et al., 2013). Within the context of our study, GG carriers may be more vulnerable when exposed to extreme cases of emotional childhood abuse, but more resilient in the context of lower levels of risk.

Limitations and Future Directions

We note several limitations in our study. First, our measure of emotional childhood abuse was a retrospective self-report and memories of childhood experiences are not always recovered reliably. Prior studies have used the CTQ in clinical and non-clinical populations to obtain reliable and valid accounts of emotional abuse (Bernstein et al., 1997; Bernstein & Fink, 1998; Scher, Stein Asmundson, McCreary, & Forde, 2001). Second, even though it is known that oxytocin is both a peripheral hormone and a central nervous system neurotransmitter with central effects in the amygdala that are believed to motivate prosocial behavior (Baumgartner et al., 2008; Campbell, 2010), the molecular functionality of the *OXTR* gene is currently unknown. Future oxytocin studies should incorporate the role of epigenetic regulatory mechanisms, in particular DNA methylation, of the *OXTR* gene and its impact on social functioning. For example, environmental effects have the potential to influence expressions of *OXTR* and lead to epigenetic changes of the genotype (Van IJzendoorn, Caspers, Bakermans-Kranenburg, Beach, & Philibert, 2010). In addition, future studies should elucidate how other genes may interact with *OXTR rs53576* and the oxytocinergic system in affecting social behavior.

Research on how biological and environmental factors interact to influence individual responses to stress and perceived social support is a significant component of future research programs aimed at advancing clinical applications. This research could inform novel approaches to help individuals adjust to environmental factors, especially ones that are early in development. Through understanding how *OXTR rs53576* relates to social behaviors and stress, effective interventions could potentially decrease emotional stress and promote positive social attributes and willingness to interact more often in

35

rewarding social behaviors, which may lead to improved health and quality of life throughout development (Kosfeld et al., 2005).

Conclusions

Early developmental environments marked by emotional childhood abuse may represent vital pathways for understanding the course of social functioning in midlife. Behavioral genetic mechanisms may provide a more direct approach for understanding the link between childhood adversity and later social functioning, which may be a significant contributing factor to mental and physical health risks in midlife. Our findings suggest that *OXTR rs53576*, in particular, may have unique implications for examining the link between negative childhood environments and social functioning in midlife.

References

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.

Anda, R. F., Felitti, V. J., Bremner, J. D., Walker, J. D., Whitfield, C. H., Perry, B. D., ... & Giles, W. H. (2006). The enduring effects of abuse and related adverse experiences in childhood. *European Archives of Psychiatry and Clinical Neuroscience*, *256*(3), 174-186.

Antonucci, T. C. (2001). Social relations an examination of social networks, social support. *Handbook of the Psychology of Aging*, *3*, 427-453.

Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2008). Oxytocin receptor (OXTR) and serotonin transporter (5-HTT) genes associated with observed parenting. *Social Cognitive and Affective Neuroscience*, *3*(2), 128-134.

Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2014). A sociability gene? Meta analysis of oxytocin receptor genotype effects in humans. *Psychiatric Genetics, Genetics*, *24*(2), 45-51.

Baltes, P. B. (1987). Theoretical propositions of life-span developmental psychology: On the dynamics between growth and decline. *Developmental Psychology*, *23*(5), 611.

Barraza, J. A., & Zak, P. J. (2009). Empathy toward strangers triggers oxytocin release and subsequent generosity. *Annals of the New York Academy of Sciences, 1167*(1), 182-189.

Bartz, J. A., & Hollander, E. (2006). The neuroscience of affiliation: forging links between basic and clinical research on neuropeptides and social behavior. *Hormones and Behavior*, *50*(4), 518-528.

Bartz, J. A., Zaki, J., Bolger, N., & Ochsner, K. N. (2011). Social effects of oxytocin in humans: context and person matter. *Trends in Cognitive Sciences*, *15*(7), 301-309.

Baumgartner, T., Heinrichs, M., Vonlanthen, A., Fischbacher, U., & Fehr, E. (2008). Oxytocin shapes the neural circuitry of trust and trust adaptation in humans. *Neuron*, *58*(4), 639-650.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*(3), 497.

Beeghly, M., & Cicchetti, D. (1994). Child maltreatment, attachment, and the self system: Emergence of an internal state lexicon in toddlers at high social risk. *Development and Psychopathology*, *6*(1), 5-30.

Belsky, J., Jonassaint, C., Pluess, M., Stanton, M., Brummett, B., & Williams, R. (2009). Vulnerability genes or plasticity genes? *Molecular Psychiatry*, *14*(8), 746-754.

Belsky, J., & Pluess, M. (2009). Beyond diathesis stress: differential susceptibility to environmental influences. *Psychological Bulletin*, *135*(6), 885.

Bernstein, D. P., Ahluvalia, T., Pogge, D., & Handelsman, L. (1997). Validity of the Childhood Trauma Questionnaire in an adolescent psychiatric population. *Journal of the American Academy of Child & Adolescent Psychiatry*, *36*(3), 340-348.

Bernstein, D. P., & Fink, L. (1998). *Childhood trauma questionnaire: A retrospective self-report: Manual*. Psychological Corporation.

Bernstein, D. P., Stein, J. A., Newcomb, M. D., Walker, E., Pogge, D., Ahluvalia, T., ... & Zule, W. (2003). Development and validation of a brief screening version of the Childhood Trauma Questionnaire. *Child Abuse & Neglect*, *27*(2), 169-190.

Berzenski, S. R., & Yates, T. M. (2010). A developmental process analysis of the contribution of childhood emotional abuse to relationship violence. *Journal of Aggression, Maltreatment & Trauma*, *19*(2), 180-203.

Bradley, B., Davis, T. A., Wingo, A. P., Mercer, K. B., & Ressler, K. J. (2013). Family environment and adult resilience: contributions of positive parenting and the oxytocin receptor gene. *European Journal of Psychotraumatology*, *4*(1), 21659.

Bradley, B., Westen, D., Mercer, K. B., Binder, E. B., Jovanovic, T., Crain, D., ... & Heim, C. (2011). Association between childhood maltreatment and adult emotional dysregulation in a low-income, urban, African American sample: moderation by oxytocin receptor gene. *Development and Psychopathology*, *23*(2), 439-452.

Brown, D. W., Anda, R. F., Tiemeier, H., Felitti, V. J., Edwards, V. J., Croft, J. B., & Giles, W. H. (2009). Adverse childhood experiences and the risk of premature mortality. *American Journal of Preventive Medicine*, *37*(5), 389-396.

Burmeister, M., McInnis, M. G., & Zöllner, S. (2008). Psychiatric genetics: progress amid controversy. *Nature Reviews Genetics*, *9*(7), 527.

Butovskaya, P. R., Lazebny, O. E., Sukhodolskaya, E. M., Vasiliev, V. A., Dronova, D. A., Fedenok, J. N., ... & Butovskaya, M. L. (2016). Polymorphisms of two loci at

the oxytocin receptor gene in populations of Africa, Asia and South Europe. *BMC Genetics*, *17*(1), 17.

Cacioppo, J. T., & Cacioppo, S. (2014). Social relationships and health: The toxic effects of perceived social isolation. *Social and Personality Psychology Compass*, *8*(2), 58-72.

Campbell, A. (2010). Oxytocin and human social behavior. *Personality and Social Psychology Review*, *14*(3), 281-295.

Caspi, A., McClay, J., Moffitt, T. E., Mill, J., Martin, J., Craig, I. W., ... & Poulton, R. (2002). Role of genotype in the cycle of violence in maltreated children. *Science, 297*(5582), 851-854.

Caspi, A., Sugden, K., Moffitt, T. E., Taylor, A., Craig, I. W., Harrington, H., ... & Poulton, R. (2003). Influence of life stress on depression: moderation by a polymorphism in the 5HTT gene. *Science*, *301*(5631), 386-389.

Chen, F. S., Kumsta, R., von Dawans, B., Monakhov, M., Ebstein, R. P., & Heinrichs, M. (2011). Common oxytocin receptor gene (OXTR) polymorphism and social support interact to reduce stress in humans. *Proceedings of the National Academy of Sciences*, *108*(50), 19937-19942.

Chen, E., Turiano, N. A., Mroczek, D. K., & Miller, G. E. (2016). Association of reports of childhood abuse and all-cause mortality rates in women. *JAMA Psychiatry, 73*(9), 920-927.

Choudhry, S., Coyle, N. E., Tang, H., Salari, K., Lind, D., Clark, S. L., ... & Matallana, H. (2006). Population stratification confounds genetic association studies among Latinos. *Human Genetics*, *118*(5), 652-664.

Clifford, S., & Lemery-Chalfant, K. (2015). Molecular genetics of resilience. *Genetics of Psychological Well-Being: The Role of Heritability and Genetics in Positive Psychology*, 177-192.

Cloitre, M., Stolbach, B. C., Herman, J. L., Kolk, B. V. D., Pynoos, R., Wang, J., & Petkova, E. (2009). A developmental approach to complex PTSD: Childhood and adult cumulative trauma as predictors of symptom complexity. *Journal of Traumatic Stress*, *22*(5), 399-408.

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin*, *98*(2), 310.

Colman, R. A., & Widom, C. S. (2004). Childhood abuse and neglect and adult intimate relationships: A prospective study. *Child Abuse & Neglect*, *28*(11), 1133-1151.

Cornelis, M. C., Glymour, M. M., Chang, S. C., Tchetgen, E. J. T., Liang, L., Koenen, K. C., ... & Kubzansky, L. D. (2012). Oxytocin receptor (OXTR) is not associated with optimism in the Nurses' Health Study. *Molecular Psychiatry*, *17*(12), 1157.

Davey, A., Eggebeen, D. J., & Savla, J. (2007). Parental marital transitions and instrumental assistance between generations: A within-family longitudinal analysis. *Advances in Life Course Research*, *12*, 221-242.

DeWall, C. N., Deckman, T., Pond Jr, R. S., & Bonser, I. (2011). Belongingness as a core personality trait: How social exclusion influences social functioning and personality expression. *Journal of Personality*, *79*(6), 1281-1314.

Ditzen, B., Schaer, M., Gabriel, B., Bodenmann, G., Ehlert, U., & Heinrichs, M. (2009). Intranasal oxytocin increases positive communication and reduces cortisol levels during couple conflict. *Biological Psychiatry*, *65*(9), 728-731.

Domes, G., Heinrichs, M., Michel, A., Berger, C., & Herpertz, S. C. (2007). Oxytocin improves "mind-reading" in humans. *Biological Psychiatry*, *61*(6), 731-733.

Donaldson, Z. R., & Young, L. J. (2008). Oxytocin, vasopressin, and the neurogenetics of sociality. *Science*, *322*(5903), 900-904.

Downs, W. R., & Harrison, L. (1998). Childhood maltreatment and the risk of substance problems in later life. *Health & Social Care in the Community*, *6*(1), 35-46.

Doucet, J., & Aseltine Jr, R. H. (2003). Childhood family adversity and the quality of marital relationships in young adulthood. *Journal of Social and Personal Relationships*, *20*(6), 818-842.

Ebstein, R. P., Israel, S., Chew, S. H., Zhong, S., & Knafo, A. (2010). Genetics of human social behavior. *Neuron*, *65*(6), 831-844.

Ellis, B. J., Boyce, W. T., Belsky, J., Bakermans-Kranenburg, M. J., & Van IJzendoorn, M. H. (2011). Differential susceptibility to the environment: An evolutionary–neurodevelopmental theory. *Development and Psychopathology, 23*(1), 7-28.

Feldman, R., Weller, A., Zagoory-Sharon, O., & Levine, A. (2007). Evidence for a neuroendocrinological foundation of human affiliation: plasma oxytocin levels across pregnancy and the postpartum period predict mother-infant bonding. *Psychological Science*, *18*(11), 965-970.

Fries, A. B. W., Ziegler, T. E., Kurian, J. R., Jacoris, S., & Pollak, S. D. (2005). Early

experience in humans is associated with changes in neuropeptides critical for regulating social behavior. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(47), 17237-17240.

Galbally, M., Lewis, A. J., IJzendoorn, M. V., & Permezel, M. (2011). The role of oxytocin in mother-infant relations: a systematic review of human studies. *Harvard Review of Psychiatry*, *19*(1), 1-14.

Germine, L., Dunn, E. C., McLaughlin, K. A., & Smoller, J. W. (2015). Childhood adversity is associated with adult theory of mind and social affiliation, but not face processing. *PloS One*, *10*(6), e0129612.

Gimpl, G., & Fahrenholz, F. (2001). The oxytocin receptor system: structure, function, and regulation. *Physiological Reviews*, *81*(2), 629-683.

Goldberg, L. R. (1992). The development of markers for the Big-Five factor structure. *Psychological Assessment,* 4(1), 26.

Gonzaga, G. C., Turner, R. A., Keltner, D., Campos, B., & Altemus, M. (2006). Romantic love and sexual desire in close relationships. *Emotion*, *6*(2), 163.

Gregory, A. M., Caspi, A., Moffitt, T. E., & Poulton, R. (2006). Family conflict in childhood: A predictor of later insomnia. *Sleep*, *29*(8), 1063-1067.

Guastella, A. J., Mitchell, P. B., & Dadds, M. R. (2008). Oxytocin increases gaze to the eye region of human faces. *Biological Psychiatry*, *63*(1), 3-5.

Heim, C., Young, L. J., Newport, D. J., Mletzko, T., Miller, A. H., & Nemeroff, C. B. (2009). Lower CSF oxytocin concentrations in women with a history of childhood abuse. *Molecular Psychiatry*, *14*(10), 954.

Heinrichs, M., von Dawans, B., & Domes, G. (2009). Oxytocin, vasopressin, and human social behavior. *Frontiers in Neuroendocrinology*, *30*(4), 548-557.

Heinrichs, M., Baumgartner, T., Kirschbaum, C., & Ehlert, U. (2003). Social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress. *Biological Psychiatry*, *54*(12), 1389-1398.

Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: A meta-analytic review. *PLoS Medicine*, *7*(7), e1000316.

Hostinar, C. E., Cicchetti, D., & Rogosch, F. A. (2014). Oxytocin receptor gene polymorphism, perceived social support, and psychological symptoms in maltreated adolescents. *Development and Psychopathology*, *26*(2), 465-477.

House, J. S., Umberson, D., & Landis, K. R. (1988). Structures and processes of social support. *Annual Review of Sociology*, *14*(1), 293-318.

Infurna, F. J., & Luthar, S. S. (2016). Resilience to major life stressors is not as common as thought. *Perspectives on Psychological Science*, *11*(2), 175-194.

Infurna, F. J., Rivers, C. T., Reich, J., & Zautra, A. J. (2015). Childhood trauma and personal mastery: Their influence on emotional reactivity to everyday events in a community sample of middle-aged adults. *PloS One*, *10*(4), e0121840.

Inoue, T., Kimura, T., Azuma, C., Inazawa, J., Takemura, M., Kikuchi, T., ... & Saji, F. (1994). Structural organization of the human oxytocin receptor gene. *Journal of Biological Chemistry*, *269*(51), 32451-32456.

Insel, T. R., & Young, L. J. (2001). The neurobiology of attachment. *Nature Reviews Neuroscience*, *2*(2), 129.

Jaccard, J., Turrisi, R., & Wan, C. K. (1990). *Interaction effects in multiple regression*. Newbury Park, CA: Sage.

Johnson, J. G., Cohen, P., Gould, M. S., Kasen, S., Brown, J., & Brook, J. S. (2002). Childhood adversities, interpersonal difficulties, and risk for suicide attempts during late adolescence and early adulthood. *Archives of General Psychiatry*, *59*(8), 741-749.

Kahn, R. L., & Miller, N. E. (1978). Assessment of altered brain function in the aged. In *The Clinical Psychology of Aging* (pp. 43-69). Springer, Boston, MA.

Karg, K., Burmeister, M., Shedden, K., & Sen, S. (2011). The serotonin transporter promoter variant (5-HTTLPR), stress, and depression meta-analysis revisited: evidence of genetic moderation. *Archives of General Psychiatry*, *68*(5), 444-454.

Kim, J., & Cicchetti, D. (2010). Longitudinal pathways linking child maltreatment, emotion regulation, peer relations, and psychopathology. *Journal of Child Psychology and Psychiatry*, *51*(6), 706-716.

Kim, H. S., Sherman, D. K., Sasaki, J. Y., Xu, J., Chu, T. Q., Ryu, C., ... & Taylor, S. E. (2010). Culture, distress, and oxytocin receptor polymorphism (OXTR) interact to influence emotional support seeking. *Proceedings of the National Academy of Sciences*, *107*(36), 15717-15721.

Knafo, A., & Plomin, R. (2006). Prosocial behavior from early to middle childhood: genetic and environmental influences on stability and change. *Developmental Psychology*, *42*(5), 771.

Koenig, A. L., Cicchetti, D., & Rogosch, F. A. (2004). Moral development: The association between maltreatment and young children's prosocial behaviors and moral transgressions. *Social Development*, *13*(1), 87-106.

Kogan, A., Saslow, L. R., Impett, E. A., Oveis, C., Keltner, D., & Saturn, S. R. (2011). Thin slicing study of the oxytocin receptor (OXTR) gene and the evaluation and expression of the prosocial disposition. *Proceedings of the National Academy of Sciences*, *108*(48), 19189-19192.

Kosfeld, M., Heinrichs, M., Zak, P. J., Fischbacher, U., & Fehr, E. (2005). Oxytocin increases trust in humans. *Nature*, *435*(7042), 673.

Krueger, F., Parasuraman, R., Iyengar, V., Thornburg, M., Weel, J., Lin, M., ... & Lipsky, R. (2012). Oxytocin receptor genetic variation promotes human trust behavior. *Frontiers in Human Neuroscience*, *6*(4), 1-9.

Kumsta, R., & Heinrichs, M. (2013). Oxytocin, stress and social behavior: neurogenetics of the human oxytocin system. *Current Opinion in Neurobiology*, *23*(1), 11-16.

Lamphear, V. S. (1985). The impact of maltreatment on children's psychosocial adjustment: A review of the research. *Child Abuse & Neglect*, *9*(2), 251-263.

Landgraf, R., & Neumann, I. D. (2004). Vasopressin and oxytocin release within the brain: a dynamic concept of multiple and variable modes of neuropeptide communication. *Frontiers in Neuroendocrinology*, *25*(3-4), 150-176.

Lansford, J. E. (2000). Family relationships, friendships, and well-being in the United States and Japan. Dissertation Abstracts International, 61(3).

Leavy, R. L. (1983). Social support and psychological disorder: A review. *Journal of Community Psychology*, *11*(1), 3-21.

Li, J., Zhao, Y., Li, R., Broster, L. S., Zhou, C., & Yang, S. (2015). Association of oxytocin receptor gene (OXTR) rs53576 polymorphism with sociality: a meta-analysis. *PloS One*, *10*(6), e0131820.

Lucht, M. J., Barnow, S., Sonnenfeld, C., Rosenberger, A., Grabe, H. J., Schroeder, W., ... & Rosskopf, D. (2009). Associations between the oxytocin receptor gene (OXTR) and affect, loneliness and intelligence in normal subjects. *Progress in Neuro Psychopharmacology and Biological Psychiatry*, *33*(5), 860-866.

Luthar, S. S., Cicchetti, D., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development*, *71*(3), 543-562.

Luthar, S. S., Crossman, E. J., & Small, P. J. (2015). Resilience and adversity. *Handbook of Child Psychology and Developmental Science*, *3*, 247-286.

Luthar, S. S. (Ed.). (2003). *Resilience and vulnerability: Adaptation in the context of childhood adversities*. Cambridge University Press.

MacMillan, H. L., Fleming, J. E., Streiner, D. L., Lin, E., Boyle, M. H., Jamieson, E., ... & Beardslee, W. R. (2001). Childhood abuse and lifetime psychopathology in a community sample. *American Journal of Psychiatry*, *158*(11), 1878-1883.

Masten, A. S., & Cicchetti, D. (2010). Developmental cascades. *Development and Psychopathology*, *22*(3), 491-495.

McGloin, J. M., & Widom, C. S. (2001). Resilience among abused and neglected children grown up. *Development and Psychopathology*, *13*(4), 1021-1038.

McQuaid, R. J., McInnis, O. A., Stead, J. D., Matheson, K., & Anisman, H. (2013). A paradoxical association of an oxytocin receptor gene polymorphism: early-life adversity and vulnerability to depression. *Frontiers in Neuroscience*, *7*, 128.

Meyer-Lindenberg, A., Domes, G., Kirsch, P., & Heinrichs, M. (2011). Oxytocin and vasopressinin the human brain: social neuropeptides for translational medicine. *Nature Reviews Neuroscience*, *12*(9), 524-538.

Miller, G. E., Chen, E., & Parker, K. J. (2011). Psychological stress in childhood and susceptibility to the chronic diseases of aging: moving toward a model of behavioral and biological mechanisms. *Psychological Bulletin*, *137*(6), 959.

Neumann, I. D. (2002). Involvement of the brain oxytocin system in stress coping: Interactions with the hypothalamo-pituitary-adrenal axis. *Progressions in Brain Research, 139,* 147–162.

Nielsen, L., & Mather, M. (2011). Emerging perspectives in social neuroscience and neuroeconomics of aging. *Social Cognitive and Affective Neuroscience*, *6*(2), 149-164

Parrott, T. M., & Bengtson, V. L. (1999). The effects of earlier intergenerational affection, normative expectations, and family conflict on contemporary exchanges of help and support. *Research on Aging*, *21*(1), 73-105.

Poulin, M. J., & Holman, E. A. (2013). Helping hands, healthy body? Oxytocin receptor gene and prosocial behavior interact to buffer the association between stress and physical health. *Hormones and Behavior*, *63*(3), 510-517.

Poulin, M. J., Holman, E. A., & Buffone, A. (2012). The neurogenetics of nice: receptor genes for oxytocin and vasopressin interact with threat to predict prosocial behavior. *Psychological Science*, *23*(5), 446-452.

Power, C., Kuh, D., & Morton, S. (2013). From developmental origins of adult disease to life course research on adult disease and aging: insights from birth cohort studies. *Annual Review of Public Health*, *34*, 7-28.

Pruchno, R. A., Wilson-Genderson, M., & Cartwright, F. (2010). A two-factor model of successful aging. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *65*(6), 671-679.

Repetti, R. L., Taylor, S. E., & Seeman, T. E. (2002). Risky families: family social environments and the mental and physical health of offspring. *Psychological Bulletin*, *128*(2), 330.

Robins, R. W., Caspi, A., & Moffitt, T. E. (2002). It's not just who you're with, it's who you are: Personality and relationship experiences across multiple relationships. *Journal of Personality*, *70*(6), 925-964.

Rodrigues, S. M., Saslow, L. R., Garcia, N., John, O. P., & Keltner, D. (2009). Oxytocin receptor genetic variation relates to empathy and stress reactivity in humans. *Proceedings of the National Academy of Sciences*, *106*(50), 21437-21441.

Rogosch, F. A., Cicchetti, D., & Aber, J. L. (1995). The role of child maltreatment in early deviations in cognitive and affective processing abilities and later peer relationship problems. *Development and Psychopathology*, *7*(4), 591-609.

Rogosch, F. A., Dackis, M. N., & Cicchetti, D. (2011). Child maltreatment and allostatic load: Consequences for physical and mental health in children from low-income families. *Development and Psychopathology*, *23*(4), 1107-1124.

Saphire-Bernstein, S., Way, B. M., Kim, H. S., Sherman, D. K., & Taylor, S. E. (2011). Oxytocin receptor gene (OXTR) is related to psychological resources. *Proceedings of the National Academy of Sciences*, 201113137.

Savla, J. T., Roberto, K. A., Jaramillo-Sierra, A. L., Gambrel, L. E., Karimi, H., & Butner, L. M. (2013). Childhood abuse affects emotional closeness with family in mid-and later life. *Child Abuse & Neglect*, *37*(6), 388-399.

Schafer, M. H., Morton, P. M., & Ferraro, K. F. (2014). Child maltreatment and adult health in a national sample: Heterogeneous relational contexts, divergent effects?. *Child Abuse & Neglect, 38*(3), 395-406.

Schafer, M. H., Ferraro, K. F., & Mustillo, S. A. (2011). Children of misfortune: Early adversity and cumulative inequality in perceived life trajectories. *American Journal of Sociology*, *116*(4), 1053-1091.

Scher, C. D., Stein, M. B., Asmundson, G. J., McCreary, D. R., & Forde, D. R. (2001). The childhood trauma questionnaire in a community sample: psychometric properties and normative data. *Journal of Traumatic Stress*, *14*(4), 843-857.

Schuster, T. L., Kessler, R. C., & Aseltine, R. H. (1990). Supportive interactions, negative interactions, and depressed mood. *American Journal of Community Psychology*, *18*(3), 423-438.

Scourfield, J., Martin, N., Lewis, G., & McGuffin, P. (1999). Heritability of social cognitive skills in children and adolescents. *The British Journal of Psychiatry, 175*(6), 559-564.

Shin, S. H., Miller, D. P., & Teicher, M. H. (2013). Exposure to childhood neglect and physical abuse and developmental trajectories of heavy episodic drinking from early adolescence into young adulthood. *Drug and Alcohol Dependence*, *127*(1), 31-38.

Shtir, C. J., Marjoram, P., Azen, S., Conti, D. V., Le Marchand, L., Haiman, C. A., & Varma, R. (2009). Variation in genetic admixture and population structure among Latinos: the Los Angeles Latino ye study (LALES). *BMC Genetics*, *10*(1), 71.

Smearman, E. L., Almli, L. M., Conneely, K. N., Brody, G. H., Sales, J. M., Bradley, B., ... & Smith, A. K. (2016). Oxytocin receptor genetic and epigenetic variations: association with child abuse and adult psychiatric symptoms. *Child Development, 87*(1), 122-134.

Springer, K. W., Sheridan, J., Kuo, D., & Carnes, M. (2007). Long-term physical and mental health consequences of childhood physical abuse: Results from a large population-based sample of men and women. *Child Abuse & Neglect*, *31*(5), 517-530.

Sturge-Apple, M. L., Cicchetti, D., Davies, P. T., & Suor, J. H. (2012). Differential susceptibility in spillover between interparental conflict and maternal parenting practices: Evidence for OXTR and 5-HTT genes. *Journal of Family Psychology, 26*(3), 431.

Thoits, P. A. (2011). Mechanisms linking social ties and support to physical and mental health. *Journal of Health and Social Behavior*, *52*(2), 145-161.

Thombs, B. D., Bernstein, D. P., Ziegelstein, R. C., Scher, C. D., Forde, D. R., Walker, E. A., & Stein, M. B. (2006). An evaluation of screening questions for childhood

abuse in 2 community samples: implications for clinical practice. *Archives of Internal Medicine*, *166*(18), 2020-2026.

Tost, H., Kolachana, B., Hakimi, S., Lemaitre, H., Verchinski, B. A., Mattay, V. S., ... & Meyer–Lindenberg, A. (2010). A common allele in the oxytocin receptor gene (OXTR) impacts prosocial temperament and human hypothalamic-limbic structure and function. *Proceedings of the National Academy of Sciences, 107*(31), 13936-13941.

Uchino, B. N. (2009). Understanding the links between social support and physical health: A life-span perspective with emphasis on the separability of perceived and received support. *Perspectives on Psychological Science*, *4*(3), 236-255.

Umberson, D., Williams, K., Thomas, P. A., Liu, H., & Thomeer, M. B. (2014). Race, gender, and chains of disadvantage: Childhood adversity, social relationships, and health. *Journal of Health and Social Behavior*, *55*(1), 20-38.

van IJzendoorn, M. H., Caspers, K., Bakermans-Kranenburg, M. J., Beach, S. R., & Philibert, R. (2010). Methylation matters: interaction between methylation density and serotonin transporter genotype predicts unresolved loss or trauma. *Biological Psychiatry*, *68*(5), 405-407.

Waldinger, R. J., Schulz, M. S., Barsky, A. J., & Ahern, D. K. (2006). Mapping the road from childhood trauma to adult somatization: the role of attachment. *Psychosomatic Medicine*, *68*(1), 129-135.

Walen, H. R., & Lachman, M. E. (2000). Social support and strain from partner, family, and friends: Costs and benefits for men and women in adulthood. *Journal of Social and Personal Relationships*, *17*(1), 5-30.

Walum, H., Lichtenstein, P., Neiderhiser, J. M., Reiss, D., Ganiban, J. M., Spotts, E. L., ... & Westberg, L. (2012). Variation in the oxytocin receptor gene is associated with pair-bonding and social behavior. *Biological Psychiatry*, *71*(5), 419-426.

Warner, D. F., & Hayward, M. D. (2006). Early-life origins of the race gap in men's mortality. *Journal of Health and Social Behavior*, *47*(3), 209-226.

Whitelock, C. F., Lamb, M. E., & Rentfrow, P. J. (2013). Overcoming trauma: Psychological and demographic characteristics of child sexual abuse survivors in adulthood. *Clinical Psychological Science*, *1*(4), 351-362.

Wilson, R. S., Krueger, K. R., Arnold, S. E., Barnes, L. L., de Leon, C. F. M., Bienias, J. L., & Bennett, D. A. (2006). Childhood adversity and psychosocial adjustment in old age. *The American Journal of Geriatric Psychiatry*, *14*(4), 307-315.

Wise, L. A., Zierler, S., Krieger, N., & Harlow, B. L. (2001). Adult onset of major depressive disorder in relation to early life violent victimisation: A case-control study. *The Lancet*, *358*(9285), 881-887.

Young, J. C., & Widom, C. S. (2014). Long-term effects of child abuse and neglect on emotion processing in adulthood. *Child Abuse & Neglect*, *38*(8), 1369-1381.

Zak, P. J., Stanton, A. A., & Ahmadi, S. (2007). Oxytocin increases generosity in humans. *PloS One*, *2*(11), e1128.

Zuckerman, M. (1999). Diathesis-stress models. In M. Zuckerman (Ed.), *Vulnerability to psychopathology: A biosocial model* (pp. 3–23). Washington, DC: American Psychological Association. doi:10.1037/10316-001.