OXYTOCIN'S EFFECTS ON WELL-BEING AND SOCIAL INTERACTIONS

THESIS

Presented to the Honors Committee of
Texas State University-San Marcos
in Partial Fulfillment
of the Requirements

for Graduation in the Honors College

by

Chasley B. Jones

San Marcos, Texas
May 2014

OXYTOCIN'S EFFECTS ON WELL-BEING AND SOCIAL INTERACTIONS

Thesis Supervisor:

_____

Crystal D. Oberle, Ph.D.
Department of Psychology

Approved:

_____

Heather C. Galloway, Ph.D.
Dean, Honors College

COPYRIGHT

by

Chasley B. Jones

2014

FAIR USE AND AUTHOR'S PERMISSION STATEMENT

Fair Use

This work is protected by the Copyright Laws of the United States (Public Law 94-553, section 107). Consistent with fair use as defined in the Copyright Laws, brief quotations from this material are allowed with proper acknowledgment. Use of this material for financial gain without the author's express written permission is not allowed.

Duplication Permission

As the copyright holder of this work I, Chasley B. Jones, authorize duplication of this work, in whole or in part, for educational or scholarly purposes only.

ACKNOWLEDGEMENTS

I would like to specially thank my adviser for this project, Dr. Crystal Oberle. Dr. Oberle has helped with refining this charcoal piece that I have written into a gem. I would also like to thank my other editors who put time into taking my unidentifiable ideas and helping me build them into a conveyable expression of ideas.

TABLE OF CONTENTS

Page

ABSTRACT

This thesis provides a critical review of past research on the different psychological and behavioral effects of the hormone oxytocin. The first part of the review presents research investigating the positive effects of oxytocin on social interactions through empathy, sexual motivation, and response to betrayal. The second part of the review presents research investigating the positive effects of oxytocin on psychological well-being through a diminished response to stress and through lowered levels of anxiety and depression.

I. INTRODUCTION

Oxytocin is a mammalian neurohypophysial hormone. It was originally named from the Greek words oxys, and tokos, which mean *quick birth*. This hormone acts primarily as a neuromodulator in the brain, acting primarily as an inhibitory neurotransmitter that affects many processes in the body. Oxytocin is a nonapeptide (i.e., 9 amino acids; see Figure 1) that is synthesized in the hypothalamus and secreted by the posterior pituitary gland, which is the major source of oxytocin in the blood (Gimpl & Fahrenholz, 2001). Oxytocin is also produced in various parts of the body, and the receptors are located in the gastrointestinal tract, heart, testes, uterus, placenta, amnion, corpus luteum, thymus, adipocytes, pancreas, and kidneys (Kiss & Mikkelsen, 2005). Oxytocin cannot be delivered orally because it will be broken down in the gastrointestinal tract. For this reason, oxytocin must be administered through a nasal spray. Also, synthetic versions of oxytocin are sold as medication under the names Pitocin and Syntocinon.

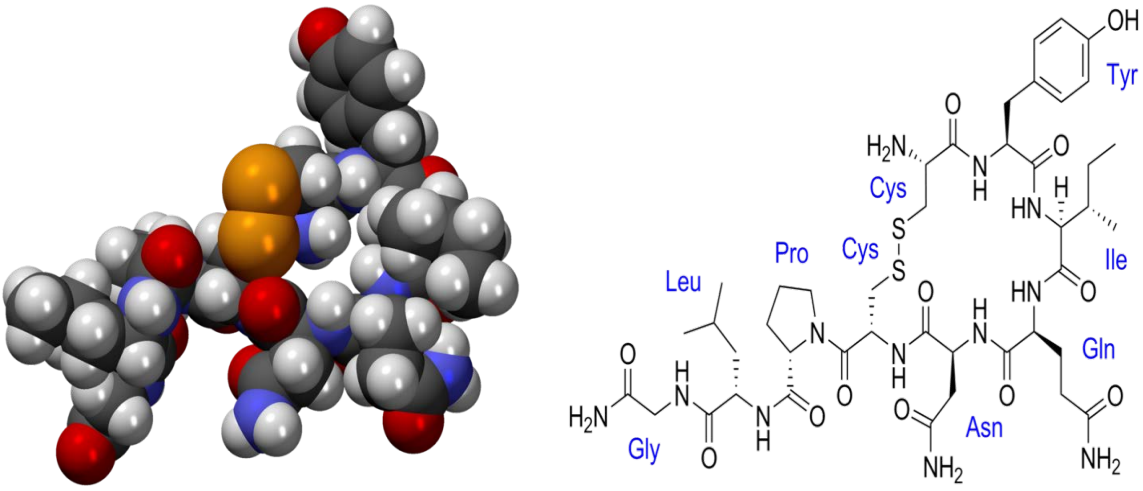

Figure 1. Molecular structure of oxytocin.

Oxytocin has many secondary functions as a hormone. Oxytocin causes the letdown reflex in lactating mothers; this is where mammary glands release the milk into subareolar sinuses, before being excreted through the nipple. Oxytocin also causes contractions during the second and third stages of labor, and plays a role in cervical dilation before birth. The hormone can also have an effect in wound healing. Oxytocin decreases certain cytokines which can modulate inflammation, which would cause healing to ensue quicker.

Aside from those functions, oxytocin receptors are distributed in various brain regions associated with psychological well-being and behavior, particularly positive social interactions (Landgraf, & Neumann, 2004). Oxytocin can affect pair bonding, maternal care, sexual behavior, and the ability to form normal social attachments (Carter, 1998). Oxytocin affects the social distance between men and women, and it may be partially responsible for sexual attraction and monogamous pair bonding. Oxytocin can also affect generosity, trust, and fear. Due to the fact that oxytocin guides these three main characteristics in humanity, it is oxytocin that controls a significant component of our social atmosphere. With a broader understanding of the hormone's effect on the brain, we can understand the dynamic picture that oxytocin plays.

For this thesis, I have conducted a critical review of past research with the goal of achieving a central understanding of what oxytocin is, and what effects it has on both sexes in humanity. This review first presents research investigating the effects of oxytocin on social interactions through empathy, sexual motivation, and response to betrayal. It then presents research investigating the effects of oxytocin on psychological well-being through a diminished response to stress and through lowered levels of anxiety

and depression. This review also provides a foundation for future research. Included in the composition of the research is my own critique of the individual studies and notes where experiments can be improved or faults that may have created threats to validity. By doing this critical review, I am providing an opportunity for researchers to find weak points and investigate to find the truth hidden in the trust hormone. As a side note, any research that has been done is always progressive towards discovering the truth about a topic.

II. COMPREHENSIVE REVIEW

The review of research below is organized to flow like that of progressive human relations, beginning with empathy that allows for interpersonal attraction; moving to sexual motivation, couples, and trust betrayal that are components of romantic relationships; and ending with stress, anxiety, and depression that the individuals in the relationship may experience. For each of these areas, the research investigates how oxytocin affects the behavioral constructs.

Empathy

As I have defined in the above sections, oxytocin is important in interpersonal information processing and behavior. Therefore, it would be easy to deduce that oxytocin affects empathetic response. For this reason, I have chosen to begin with an article by Theodoridou, Rowe, and Mohr (2013), who begin to take on the issue of empathy with respect to oxytocin levels. In this experiment, the researchers were interested in investigating the possibility that oxytocin might exert sex-specific effects on empathy and perspective taking and tested an equal number of women and men.

Mohr et al. created two independent studies using comparable double-blind placebo-controlled between-subjects designs to assess healthy individuals' empathy as a function of nasal oxytocin administration. In Study 1, the participants were provided with a vignette in which a person's unfortunate plight was described. Participants then rated their empathetic feelings toward the individual, thereby directly linking the self-reported empathic response to an individual's plight. For Study 2, they used a more implicit strategy by assessing reaction times for perspective taking in a computerized task. In this task, participants see back-facing and front facing human figures sequentially on the

computer screen and have to match the own perspective with the one of the figure. Matching their own body position with that of a front-facing figure is cognitively more challenging than matching it with a back-facing figure as reflected in enhanced reaction times. The hypothesis was, if oxytocin enhances the assessment format chosen, then it is expected that increased oxytocin availability enhances individuals' empathy in both studies, leading to higher empathic concern ratings in Study 1 and potentially faster reaction times in Study 2. Yet, if explicit, self-report measures of empathy bias desirable responding, the effect of oxytocin might not be observed in Study 1, with the 3PP task in Study 2 producing more pertinent results, at least statistically.

Both studies were conducted in two sessions; a baseline session performed by participants at home and a laboratory session for which participants came to the University. Participants were required to be fluent English speakers, who were not on any medications, and have no medical reason to be taking OT. In the case of female participants, they were not taken if pregnant or breastfeeding. Participation was recruited through poster advertisement in and around the university, through emails to various departments, or postings on the university's job listings. Participants provided demographic information and filled in self-report questionnaires. Study 1 contained 96 participants (mainly students, mean age: 21.4); 51 (25 males) received oxytocin, and 45 (23 males) received placebo. Study 2 had 120 participants (mainly students, mean age: 22.4); 60 (30 males) received oxytocin, and 60 (30 males) received placebo.

Participants were instructed to abstain from alcohol, caffeine, and nicotine for 24 hours before testing and from food and drink (except water) for two hours before testing. In a double-blind procedure, participants were randomly assigned to self-administer a

small intranasal dose of either 24 IU oxytocin (Syntocinon Spray, Novartis, 3 puffs per nostril, each puff containing 4 IU oxytocin), or placebo (containing the same ingredients, but oxytocin, to the oxytocin nasal spray). After a waiting period of 25–30 min, participants completed the task battery including the empathy vignette task (Study 1) and the 3PP-task (Study 2). Tasks were presented in two blocks, randomized in order. In Study 1, the empathy scenario task was administered either 35 or 55 min after drug administration. In Study 2, the 3PP-task was completed either 35 or 60 min after drug administration. The researchers do note that time window is sensitive to oxytocin effects; however, oxytocin reaches its peak plasma level at approximately 30 min after a dose of 26 IU intranasal oxytocin.

For Study 1, participants were read a story about the plight of a university student. Immediately afterwards, the experimenter read 10 adjectives, each of which participants verbally rated on a 7-point visual analog scale according to how they felt while listening to the story (1—not at all felt, 7—very strongly felt). Half of the adjectives reflect the empathetic concern of the participant while the other half reflect on feelings of personal distress. They calculated mean scores for empathic concern responses and personal distress responses, separately (range of scores 1–7 with higher scores reflecting greater empathic concern and personal distress, respectively), to account for the possibility that these two dimensions are differently influenced by oxytocin and/or sex.

For Study 2, participants received the written instruction that the following task would assess their empathic ability, and verbal instruction was included to ensure that the task was introduced as a test of empathic abilities. Participants then received both written and verbal instructions to imagine being in the other person’s shoes. Following the

instructions, a slide with the demonstration of the task procedure was presented for 6 seconds. Each picture was presented 10 times resulting in 80 experimental trials.

A MANOVA was used to analyze data from Study 1 and a mixed model ANOVA was used to compare the data statistically. The discussions implied by these tests are not particularly important because the tests compare the right relationships the researchers were looking to test. The MANOVA in Study 1 showed that OT had no effect on empathetic concern, or personal distress ratings. A significant effect of participant sex was found on personal distress scores (see Figure 2).

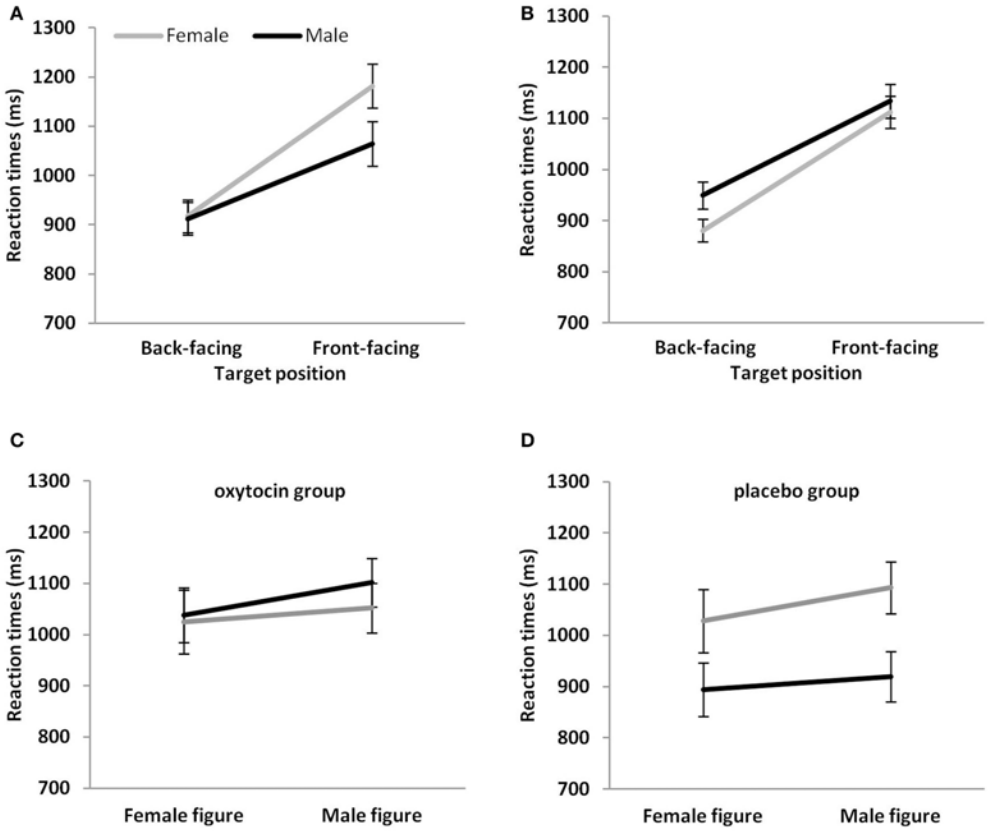

Figure 2. Mean reaction times (A) of male and female participants to target figures in the back and front-facing position, (B) to male and female target figures in the back and front-facing position, (C) of male and female participants to target figures in the OT group and (D) the placebo group. *Vertical bars indicate standard errors (Theodoridou, Rowe, & Mohr, 2013).

From this research, it was concluded that oxytocin does not affect empathy; however, there was a correlation between empathy and participant sex. Also, there is a suggestive conclusion of a potential strategy change in men after consuming oxytocin as compared to placebo. Such facilitation of social perspective taking might already be present in women, regardless of which of the two drugs were consumed. Therefore, additional oxytocin availability might affect men but not women from Study 2. The problem with this research is that the experimental procedures may have had a dispersed concentration. That is, there may have been too many goals in the research to derive the truth about one. I suggest that more research be conducted on empathy as an operational behavior itself. Empathy may be hindered because of the social desirability bias.

Empathy is something that people feel pressure to have as a characteristic. Therefore, when asked, a person will most likely answer as empathetic because they feel like that is the right thing to do. Therefore, we have a swayed standard; with a swayed standard, it is difficult to achieve significance. The answer is creating a simulation for participants and have them placed into a situation where a similar plight is presented, and seeing which participants take action to lessen the pain. It does not have to be a real simulation; the researchers could have a confederate that bumps into the participant in a casual but segregated setting. The confederate can then tell a story or create a situation where the participant is asked for assistance. This way, you can gain a more credible standard for empathy to compare against through the means of deception.

Research also could bend toward the concern of altruism. There were hints in the article that altruism may be a testable side effect of oxytocin. It would be interesting to see in Study 1 if the researchers would have compared the relationship between the

strength of feelings of personal distress versus the concern of emotional empathy. That way, oxytocin could be tested to see if it causes males or females to pull away from selfish desires and be more altruistic by nature.

This research on empathy from the study was left a bit inconclusive. A researcher could perform more tests seeing if males can perform more favorably on a taking perspective tasks with a supplemental dose of oxytocin. That way, the public would get some more hard support for whether or not oxytocin can experimentally effect empathy among men.

Empathy can help affect the ease and happiness behind a relationship. Therefore, if empathy is increased by oxytocin, then relations between humans may be guided by the oxytocin levels of individuals in the relationships. Along those lines, what better way to test if oxytocin can help nurture a relationship than testing if sexual motivation is molded by oxytocin?

Sexual Motivation

Sexual motivation is an all-encompassing idea of what causes us to engage in sexual behavior or generate erotic desire for another person. In 2005, Janice Hiller looked into the topic of how feelings can lead to sexual assertions. The research was aimed more for fixing problems in committed relationships that may be causing a decline in sexual motivation. Hiller tried to find the chemical composition in the brain that generates an ideal environment for sexual exhibition.

Hiller opens her article of gender differences of sexual motivation by saying that men’s sexuality has been the concentration by researchers since oral medication for the erectile response was first introduced. Under clinical settings, the difference must be

made between motivations causing sexual behavior and a subjects ability to respond sexually. What we think and feel guide our sexual interactions. These interaction originate from interpersonal and social atmospheres. How we perceive our own sexual experiences are mediated by our own emotions and cognitions that are wrapped around our partner. It is interesting that Hiller did not include future perception with the influence of past and present perceptual manipulation. After creating an adoration of someone, that may cause past experiences to seem quite epic.

Hiller's main question is, through our bodily changes, how do our feelings and thoughts interact to lead to sexual expression? She then begins with animal brain reaction to bodily functions and parallels those interactions to humans. The pituitary gland releases neuropeptides that are needed for creating an erotic mood state. This shows that humans are not so completely different from other species suggesting that some comparisons are possible. The evolutionarily modern neocortex contains the subcortical system that governs sexual urges in humans, and that the neural patterns that construct what we know as feelings are based on the brain's interpretations of emotions. Whenever we deliberately decide to engage in sexual behavior the basis will be influence by social context, past behavior, and how you are feeling in the moment. Each of these effects is in varying degrees at different stages of life within a bio-psychosocial model.

Hiller then shifts her analysis to the loss of sexual desire and whether that is a disease or psychological problem. The operational definition that Hiller uses, which she defined by Kaplan's work in *Disorders of Sexual Desire* is a low or absent motivation to be sexual. Hiller goes on, indicating that for the most part, this problem can become prevalent when an individual, who is in a devoted relationship, develops some quirk that

makes them less likely or interested in sexual contact with their partner. This interaction can cause further disharmony because the reciprocation from the partner can be emotional withdrawal or attacking towards the sexually unmotivated partner. In studies the individuals who have been diagnosed with hypoactive sexual desire disorder according to DSM IV, are the partners who have regressed from the relationship sexually. Clinicians re-structure the problem. They take the focus from being a disease entity in a specific individual to the incompatibility for sexual intimacy between the couple. This causes the problem to now address how two relate to each other instead of one person having an illness of sorts. Moreover, clinical practices indicate that sexual withdrawal within humans is associated with negative emotional states. Positive emotions feed into the reactions for sexual intimacy while negative interactions and emotions pull away from the desire for sexual intimacy.

Hiller continues on a loss of sexual desire from a biological perspective. All humans feel a drive for sexual desire that is fueled by a sufficient level of testosterone coursing through the body. Sexual desire is influenced by interpersonal interactions and psychological interpretations from one individual towards another. Testosterone is an androgen that has a clear role in male arousal mechanisms and sexual desire, men are more sexualized due to the fact that they have 10-20 times more testosterone then their female counter parts (Bancroft, 2000). Even though males have an increase in sexual desire through the hormone testosterone, it does not mean that women have no effect from testosterone. Women are also affected by testosterone, they just do not have as much testosterone in their systems which means that their sexual desire is not as heavily influenced (Riley & Riley, 275). Previous research to the correlation between

testosterone influence on sexual desire and women has developed contradicting results. (Bancroft, 2000). Hiller concludes the loss of sexual desire saying that, apart from physiological causes, low sexual desire derives from displaying a negative emotional state that affects the interpersonal relationships. The individual has a problem that is psychological in origination rather than a dysfunction as a medical problem. It is due to the lack or negative interactions of the individual rather than some physiological problem.

Hiller then goes on to talk about how men and women differ in stimuli and sexual activity over the life course. Since these two topics stray from neuropeptide influence on sexual desire, I am guiding towards Hiller's next section in succession, Neuropeptides, Feelings and Sexual Behavior. Hiller states that oxytocin, and vasopressin are the two neuromodulators for brain chemistry, sexual behavior, and emotional states. Both of these peptide hormones are found exclusively in mammals, and are produced in the hypothalamus. During sexual activity the hypothalamus releases these hormones into the bloodstream, however if these hormones are ingested orally they will not cross the blood-brain barrier because they are digested in the gastrointestinal tract. Along the process of the sexual response cycle both men and women produce both hormones, which are manufactured by either testosterone or estrogen.

It has been found out through laboratory studies that with individual subjects women secreted more oxytocin than men during arousal and climax (Carmichael et al. 1987). Furthermore increased secretion of oxytocin during climax creates a higher intensity of orgasm produced from sexual activity (Carmichael, Warburton, Dixen, & Davidson, 1994). However in a study of only male subjects, it was found that from

baseline to climax oxytocin holds a steady gradual rise, while vasopressin displayed a different temporal pattern. Vasopressin would rise during the erectile response, then drop back towards baseline levels at ejaculation, during which oxytocin would remain at higher levels through ejaculation (Murphy, Seckel, Burton, Checkley, & Lightman, 1987). Hiller then connects the significance of neuropeptide studies in complex human actions to sexual activity and mate attachments in rodents. In rodent females there is a release of oxytocin during sexual activity and cohabitation, this implies that they do in fact form a commitment to a mate. Meanwhile males release the hormone vasopressin during sexual activity, which is critical for inspiring the male to become more protective and guarding of his chosen mate. (Carter, 1998; Insel, 1997). Males become ambitious and driven to acquire sex, this is called male persistency and it is also attributed to vasopressin (Panskepp, 1998). Oxytocin goes deeper than simply creating more intense orgasms. The hormone has been attributed to created close knit emotional bonds that enable a secure foundation for child-rearing purposes, along with enhancing sexual desire in both men and women (Fisher, 1999; Panskepp, 1998).

Hiller gives the next emphasis to oxytocin under her chapter titled, Sexual Responses, Emotional Bonds, and Oxytocin. Oxytocin levels are particularly important in women's awareness of sexual desire mechanisms, even though both men and women secrete oxytocin during sexual activity. For a male who is approaching a female, oxytocin is essential for successful engagement of copulation. When the oxytocin receptors become interfered with, males who approach may be rejected, struck, or attacked by a hostile female (Caldwell, Johns, Faggin, Senger, & Penderson, 1994). In rats, to prepare the females for sexual activity, the female must be psychologically prepared. Oxytocin

plays the essential role here, the hormone is released to induce an erotic state in the rodent. Only after the female is prepared will the male be able to engage in sexual activity without being attacked (Panskepp, 1998).

Hiller then switches to the human clinical population. A woman needs to fulfill an emotional attachment with a reciprocating loving partner, in order to become sexually comfortable. Therefore women who describe their relationship with negative feelings they are diagnosed with a disorder, which is staple with the issue of absence of psychological arousal (Fisher, 1999). Also intimate carnal touch and social togetherness are stimuli that will likely release oxytocin (Uvnas-Moberg, 1998). Hiller then concludes that when a relationship is nurtured with positive interactions between the two partners it will create an environment for psychological arousal developing into sexual desire. For this reason, female arousal and further the motivation for sex will be significantly handicapped by insufficient oxytocin release or with a prevalence of vasopressin. Whenever women feel neglected, hostile, or undermined by a partner then the imbalance of hormones is likely to be the cause.

Hiller did her job well reporting on the differences in sexual motivation correlated to the differences in sex of humans. She had to tackle a very large and massively complicated and deep human interaction, and she covered a lot of ground. It would have been stronger to strictly report the findings on neurochemical interactions in the brain. By doing that, Hiller would have dispelled much of the mysticism behind sex, and come at it as a purely analytical point of view. Instead of delving into the complicated interaction, which is virtually impossible to derive fact from, it would have boiled down to strictly factual reaction to neuropeptides in the brain with respect to sexual motivation.

In conclusion, the sexual motivation is not impeded due to a sufficient amount of oxytocin found in the individuals. If this is the case, then a relationship may be able to bloom forth from these now defined as empathetic and sexual beings. From there, how can oxytocin guide the new-formed couple to interact?

Couples

Taylor, Saphire-Bernstein, and Seeman (2009) designed a study to test how oxytocin and vasopressin levels were associated with distress in couples (pair-bonded relationships). Participants were 85 young adults that were in committed relationships. Of the participants, 62% were female and 38% were male, while the average age was 21.6 years. The participants that were considered young, aged from 18-34 years. Fifteen participants had only received a high school education, while six had completed some graduate work. Eight subjects were married and one was divorced. Anyone that was taking any medication affecting the endocrine system was excluded from the study.

Participants completed an online difference measure prior to their visit to the lab; the measures were over the following: Optimism, Mastery, Extraversion, Perceived Stress, Brief System Inventory, Mood and Anxiety Symptom Questionnaire, Beck Depression Inventory, and a measure developed in the Mid-Life in the United States (MIDUS) study. The last measure was a composite measure of socially supportive and unsupportive relationship behaviors. Within a week, the participants had their blood drawn and tested for oxytocin, vasopressin, testosterone, and estradiol. Blood was drawn into serum tubes containing aprotonin (500 kIU per ml of blood). Then, the samples were centrifuged at 1600 x g for 15 min at 4°C. Then the blood was stored at -80 °C.

Four (three women, vasopressin; one woman, oxytocin) cases of participants exceeding three standard deviations of hormone levels were excluded from the study. Both men and women had similar baseline oxytocin and vasopressin levels. Means for the relationship distress scale were 2.75 for women and 2.69 for men.

Plasma level oxytocin was significantly correlated to relationship distress in women. Plasma vasopressin level was significantly correlated to relationship distress in men. The correlations changed negligibly for controlling age. There was also a significant positive correlation between vasopressin (men) and oxytocin (women) with unsupportive relationship characteristics. Also, there were strong significant negative correlations between vassopressin (men) and oxytocin (women) with supportive relationship characteristics.

This is important to see that vasopressin can act in males as oxytocin works in females, which expounds on the viable hypothesis that Taylor (2006) brought up in previous research, that vasopressin serves similar relationship functions in men as oxytocin serves in women. The authors then compare these functions and mechanisms as an evolutionary trait due to our monogamous nature tying with obvious reproductive functions. Also, this is evolutionary in the way that we need to meet vital nourishment and safety in a more general sense. These findings are greatly distinctive to relationship distress and are not accounted for individual differences in potentially related personality traits.

It was important that the authors decided to exclude the small amount of outliers. These participants may have naturally had an abnormal hormone level but with such a small size and a university lab setting, it is more likely that the testing procedures were

compromised. Such a small participation size may have drastically impacted the statistical power of the data, but the authors assure us that that was not the case; inclusion of the vasopressin outliers negligibly changed the correlation reported for women.

Therefore, oxytocin in women can lead to a disposition that is more readily capable of creating a supportive and nurturing relationship among couples. Vasopressin has the same potential in men. However, what would happen if the relationship were going sour? Oxytocin can affect the construct of trust betrayal in humans.

Trust Betrayal

Developing on the idea that oxytocin affects trust in humans especially among women, authors Klackl, Pfundmair, Agroskin, and Jonas (2012) investigated the idea of oxytocin affecting trust betrayal. Since there is so much evidence for oxytocin increasing pro-social behaviors, the authors designed a trust game model to test how oxytocin may affect the idea of betrayal.

The authors used a classic model of the trust game where participants took the role of the trustor. There were either experimental, oxytocin groups or a placebo group. In the model they used, the investor was played by a computer that was programmed to betray the participant. The participant would play six rounds of the trust game and then would be informed of the investor's low trustworthiness, which would be followed by another six rounds. Anger rumination and attribution style were assessed after the trust game using questionnaires.

The construct of trust was defined as the difference between the total amount of investments prior to learning of the investor's betrayal (trials 1 through 6) and the total amount of investments after being informed about the state of the investor (trials 7

through 12). As an example of a form of trust betrayal in this scenario, the trustee gets one dollar from the bank on each trial. From that dollar he gets he chooses to invest half of it during the first six trials that he trust the investor. This concludes a total investment of 3 dollars before the betrayal. In the trials after the betrayal, the trustee may only decide to invest a dime each trial. This would result in a total investment of 1 dollar from all 6 trials after the betrayal. This would correspond to a total investment reduction of 2 dollars between the two sets of trials due to anxiety of trust betrayal.

Forty male students selected from a university were used in the study. Of these 40 students, 25 were from the psychology department. None of the participants reported health disorders or concerns. This experiment was a deceptive study and the participants were thoroughly debriefed afterwards. In this study, there was the experimental (oxytocin) group and a control (placebo) group; both of these groups were randomized. Both groups received doses 40 min before the actual study to allow oxytocin to reach peak levels in the central nervous system. Depending on whether the participant was in the experimental or control group; they received 24 IU (three puffs per nostril) of either oxytocin or a sodium chloride solution enacting as a placebo.

The researchers used a two by two ANOVA with repeated measures on the second factor. Oxytocin group compared against placebo group, against the amount of time taken in both pre and post betrayal investments. From the data, the measures showed that there was a significant time difference between participants making decisions from trial 1-6 and trials 7-12. It took more time to decide to invest after learning of the trust betrayal than before it. Although it there was no significant difference between how the participants dealt with the trust betrayal between placebo and oxytocin groups.

The authors concluded that enough evidence was shown to deduce that oxytocin affects trust partially by changing how people respond to angry ruminations. When a participant would respond to angry ruminations with different attribution styles, it showed that oxytocin may affect trust through this interaction along with simply trusting people more. Under the effects of oxytocin, angry rumination about the trust betrayal led to more non-personal attributions of the subject's actions which guided the interactive effects of OT and ruminations on trust. Subjects under the placebo group trended to display more personal attributions with increasing angry ruminations.

This study was interesting and informative. I would agree with the conclusions the researchers came to about oxytocin affecting how participants would interpret betrayal and betrayal in relation with themselves. However, it is interesting that 62.5% of an already all-male participation pool is from the field of psychology. Many in the psychology field are taught about deception and taught how to perform deception, which may give them the opportunity to read any deception in a study. Also, the trust game is a fairly popular study in the field of psychology and I imagine that many on these psychology students may have heard of the method before. Another thing to consider is that if there is such a high involvement from one department of a university, then the participants were most likely not randomly selected. The model they probably used was sending out information of where a study was being conducted and the students who responded were offered extra credit of some kind.

Also, the fact that the participation was all male was disturbing; perhaps the University of Salzburg is a boy's school, but since the test was dealing with oxytocin, there should have been some representation of females. It is not like this study was

performed at a different time. The study is from 2012, just two years ago. Therefore, it is not representative of the society the researchers are trying to stipulate of, unless that society has recently become all males, in which case I believe they may evolutionarily be wiped out soon. Again, these are not bad things, just the way this particular study was performed. The study needs to be performed again under different settings to test its universality, before it can be concluded as a truth of humanity.

Oxytocin can create an individual with a predisposed mentality that is more likely to be positive and brush off issues that may bother someone else more deeply. However, if there are enough situations that bother an individual, that individual will likely develop some stress in their life. How can oxytocin help deal with stress in a human?

Stress

Lucas-Thompson and Holman (2013) begin their research by opening with the idea that a positive supportive environment can buffer any stress. The same goes for a negative unsupportive environment forcing acute and chronic stressors to take more effect than they should. The authors want to shift the focus to understanding the role of the individual and the differences it plays in our sensitivity to social environments. Oxytocin has accrued theoretical and empirical attention as being evolutionarily involved for mammalian social behaviors that make up the caregiving behavioral system.

Oxytocin helps shape social behaviors and plays a crucial role in our responses to the social environment around us. The authors noted that oxytocin can decrease behavioral and physiological responses to stress, and suggests that with a better understanding of the oxytocin system, we may be able to understand how social environments influence mental and physical health, especially with stress.

Lucas-Thompson and Holman studied the individual differences that oxytocin influenced systems have by examining how behavioral expressions correlate with different genotypes of the oxytocin receptor gene. The correlation have been found in affecting behaviors such as social-cognitive, mental health and socio-emotional. One of the most studied oxytocin receptor genes polymorphisms is rs53576, with recent studies showing that people who express an A allele exhibit deficits in socio-emotional domains such as parenting, empathy, pro-sociality, psychological resources and positive affect. Rs53576 has also had severe effects on social functioning deficits common in autism spectrum disorders and depression.

Oxytocin induces a set of specified behaviors during periods of stress that help prolong HPA axis responses. (Taylor, 2006; Chen et al., 2011). By doing this, the oxytocin system functions to mobilize social supports and minimize the risk of depression and anxiety (Smith, & Wang, 2012). The G allele benefits more from social support when anticipating and responding to acute stressors (Chen et al., 2011).

Lucas-Thompson and Holman say that oxytocin has been studied in the setting to compare if it can facilitate positive social interactions. Outside environmental sources that are negative can cause an increase of the harmful effects of stress (Taylor, 2006). An example, when females have a high plasma level of oxytocin, they become more aware of characteristics of the social environment and more distressed by negative social experiences than females whom have lower levels of oxytocin. (Taylor, 2006). That is why Lucas-Thompson and Holman tested whether a correlation exist between negative social environments, economic stress and the outcomes of awareness were influenced by gender.

The participants in this three year longitudinal study were a representative sample of Americans. Participants in the larger study (n = 2729) were surveyed 2-3 weeks at 2, 6, 12, 18, 24, and 36 months following the 9/11/2001 attacks. Also pre-9/11 data was collected before the attacks on psychological and physiological health. Individuals were recruited by Knowledge Networks Inc. (KN), a corporation that uses random-digit-dialing involved with probability sampling in hopes to recruit and maintain a nation-wide representative panel for survey research across the internet. Surveys were conducted through a password protected account online, and KN provided internet access to those that did not have any.

For Study 1, the authors used 1296 participants who showed that they could be contacted again. From there these 1296 individuals moved to the next phase of the study that involved genetic trials. KN paid the members of this phase either $50 for participation or $75 for providing saliva. Of the 1296, 711 (55%) returned their saliva samples using OraGene kits mailed to them; 704 oxytocin genotypes were successfully identified.

Previous research showed evidence for genetic differences in oxytocin affecting stressors from social and economic troubles. This would affect mental health and functioning in a sample of subjects exposed to a central stressor. The authors found from the result of the tests that the rs53576 GG genotype may render individuals more vulnerable to mental health risks when presented with social and economic stressors. Also, they found a correlation to oxytocin providing differential susceptibility to positive social relationships in a way that protects mental health. The rs53576 A allele may serve as a plasticity allele that can help economically stressed men.

When considering these results, it important to understand how essential emotional health is when linking to stress. Some links have been made to individuals that may be genetically predisposed to handling stress better due to a specific allele expressed. Females were most affected by negative social environments regardless of genotype and stress. Males, on the other hand, were differentially susceptible to economic stress depending on oxytocin receptor gene genotype and negative social environments. Therefore, it is important to consider combined impact of stress and gender when analyzing genetic acclamation to collective stress.

With a bombardment of continual stress, an individual is likely to develop anxieties. If oxytocin has a subtle effect on stress levels by enabling a more acceptable disposition, then it is likely that oxytocin also has an effect on anxieties among humans.

Anxiety

From the research above about stress, it can be shown that stress can be reduced to a genetic allele of oxytocin. Paradoxically men show a negative correlation was found between general anxiety and oxytocin. One example is the negative correlations that were found among 90 male participants between plasma oxytocin levels and trait anxiety. Human research has shown correlations between oxytocin with low anxiety and lower psychological distress (Opacka-Juffry & Mohiyeddini, 2012).

Weisman, Zagoory-Sharon, Schneiderman, Gordon, and Feldman (2013) chose to concentrate their current study on two central goals. The first focus was to describe the distribution of characteristics of plasma oxytocin in the largest cohort of healthy persons as of 2013. The second was to investigate whether gender moderates the correlations between plasma oxytocin levels and two types of anxiety: trait anxiety (representing the

individual's general levels of stress) and attachment anxiety (stress specific to close relationships). Expectations were that high oxytocin in women would be associated with attachment-related anxiety. On the other hand, oxytocin levels in men would be associated with lower stress and anxiety.

This study included 473 participants. These participants' blood was drawn and analyzed for oxytocin levels. More than half of the participants were females (58.5%); of the females, 72.6% were mothers and 27.4% were single. Of the males, 58.7% were fathers while 41.3% were single.

For the procedure, after participants were debriefed and informed consent was acquired, the participants completed two anxiety questionnaires. The two questionnaires were the State-Trait Anxiety Inventory (STAI) and the Experience in Close Relationships (ECR) survey. After the surveys, blood was collected for lab analysis. The statistical analysis used was an independent t-test analysis.

Regardless of participants gender there was a high level of stability found with Pearson's correlations in the cases (n=323) where oxytocin was measured then re-measured 6 months after the start. In order to investigate the long term relationships between anxiety and oxytocin with the sub-samples, the study required a computed partial correlation between trait and attachment anxiety and oxytocin while controlling oxytocin levels individually for males and females. Female's attachment anxiety and oxytocin levels was the only partial correlation of significance of the set. Both the distributions showed a significant correlation. The average rank for males and females (256, and 223 respectively) suggested that the two distribution are significantly different. Also males showed a higher median oxytocin level than females (see Figure 3).

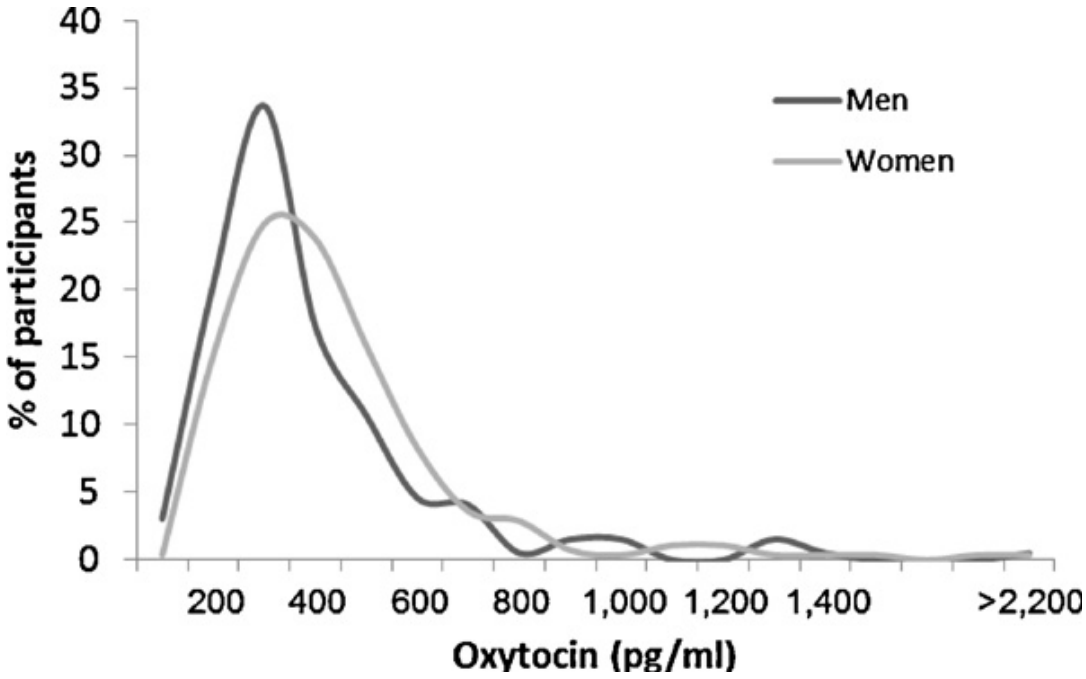

Figure 3. Plasma oxytocin levels of men and women. (Weisman, Zagoory-Sharon, Schneiderman, Gordon, & Feldman, 2013)

On the correlations between oxytocin and anxiety, the trait anxiety did not differ across genders. Plasma oxytocin was significantly correlated with trait anxiety in men, but not in women (see Figure 4). The authors also looked to see that women who were 2.5 standard deviations away from the average level of oxytocin were high in anxiety, which they found to be the case. That correlation could not be made among men. However, oxytocin was negatively correlated with attachment anxiety in men, whereas a positive correlation was found in women. This was also a similar outcome to Lucas-Thompson and Holman's (2013) researcher. No general or gender specific correlations could be found between oxytocin and state anxiety or attachment avoidance.

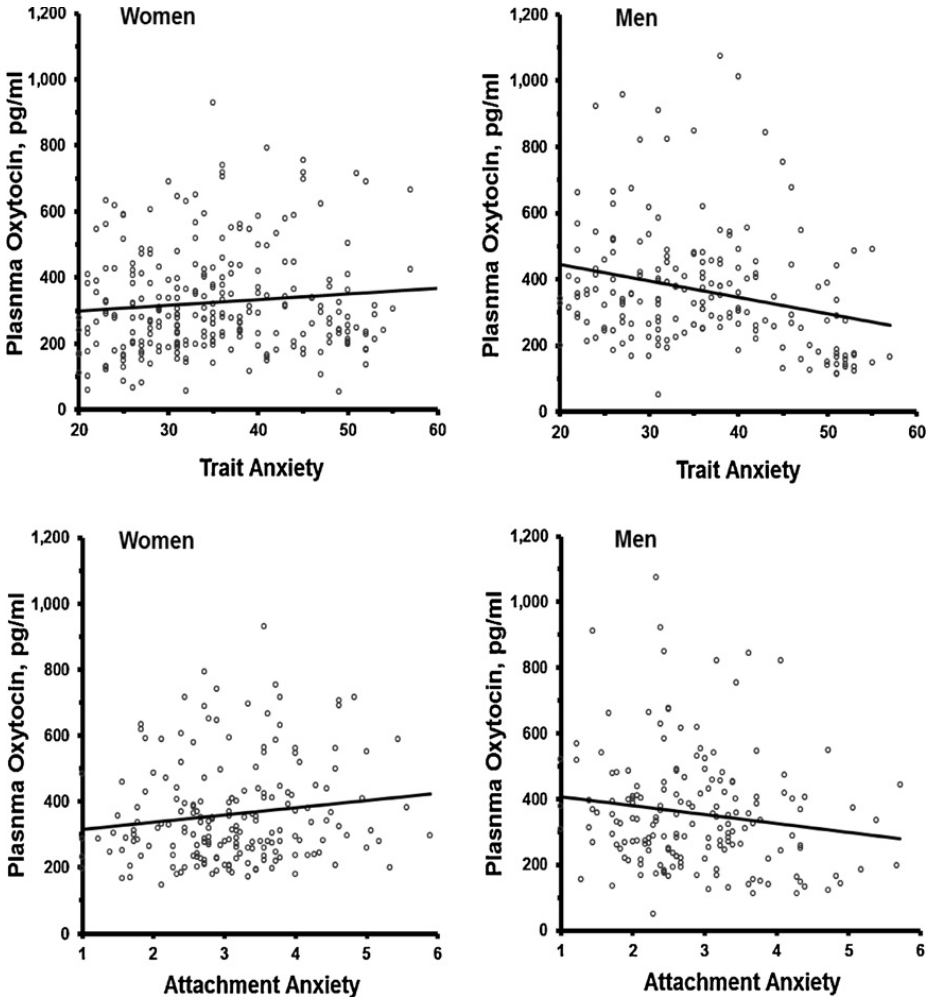

Figure 4. Relationships between plasma oxytocin levels and anxiety in men and women. (Weisman et al., 2013)

The research goes on to show that women who reported higher attachment anxiety had higher oxytocin values. Also, men with higher oxytocin reported lower trait anxiety. This suggests that oxytocin may serve an anxiolytic function in males among our population. The high correlation between high anxiety and high oxytocin levels in women link to a theory of over-exacerbation of the oxytocinergic system for women. Future research could develop or test these leading theories proposed in the research.

Limitations of the study relate to the survey type acquisition of data. Due to self-report measures of anxiety, there are weaker ties to truth than other forms of data

collection. The participants may be relatively anxious in a particular point of their day. The two measures used are considered highly reliable and have been extensively studied over many years. This study could also be completed by administering foreign oxytocin and see if the correlation exists between extra oxytocin and anxiety. It may be interesting to see if foreign administration of oxytocin has the same effects on subjects.

So, oxytocin indirectly helps soothe anxieties in men while high oxytocin levels in women correlate with high anxieties. From there, if left in anxiety for an extended periods of time, humans may slip into a slight depression. Therefore, if oxytocin may create an anxious reaction in women, and may guide a more relaxed reaction in men, then how does it affect depression in humans?

Depression

Ozsoy, Esel, and Kula (2008) tested the hypothesis of reduced oxytocinergic activity with depression in humans. The study also focused on the effect of electroconvulsive therapy and antidepressant drug treatments on oxytocin levels of depressed patients, with special regard to differences in sex.

In 1996, Zetzsche, Frasch, Jirikowski, Murck, and Steiger found that oxytocin levels tended to be if not unchanged then lower in depressed participants of their study. They reported lower levels of plasma oxytocin in depressed patients compared with similar age-control groups. However, there are also some recordings of no significant differences in plasma oxytocin and depressed patients, one of them being Van Londen et al. (1997). For the most part, there is more supporting evidence for negative correlations found between scores of symptoms of depression and anxiety with plasma oxytocin levels than not. Scantamburlo et al. (2007) conducted more recent research that supported

the correlation between oxytocin plasma levels and depression of patients. Next is Ozsoy et al.'s (2008) research to see what they found out about oxytocin and depression.

The researchers had 40 inpatients that met the criteria for major depressive disorder, or bipolar depressive episode. The determination of the patient qualifications were results from the DSM-IV and clinical interviews from two independent psychiatrists. The breakdown was 30 women and 10 men; of the 30 women, 10 were post-menopausal. Also, 29 were considered major depressive and 11 were considered having bipolar affective depressive disorder. The patients had been drug-free for 2 weeks.

The control group was 32 physically and mentally healthy individuals recruited as volunteers and hospital staff. Of the 32, 20 were women and of those 20, 5 were post-menopausal. None of the patients were using oral contraceptives or hormonal therapy. Thirteen patients did not complete the study and the rest remained in the hospital until the finish of the study.

For the test, both groups were scored on the HDRS and anxiety was rated with the CAS. Of the patients in the study, 15 were treated with ECT, 6 with SSRI, 13 with Venlafaxine, and 6 with tricyclic antidepressants. Only when the results of the HDRS derived a 50% reduction in score, did the researchers regard that score as a score responding to the treatment. Oxytocin levels were measured at both the initiation and after completion of all the treatments in the patients. Oxytocin was only measured once in the control group. ANCOVA was used to analyze the results.

Serum oxytocin levels in both pre-treatment and post-treatment were significantly lower than those in the control. However, there were no significant differences in the oxytocin levels before and after the treatments in the patients. When oxytocin levels of

sex were analyzed separately, pre-treatment levels in males did not differ from the controls. However, the female patients had lower oxytocin levels than their controls. There were no significant correlations found in oxytocin levels between men and women. Nor were there any significant correlations between oxytocin levels and the male and female control group.

It is further supported that plasma oxytocin levels may have an effect on how overwhelmed a person may feel. A person with a lower level of oxytocin may be more inclined to fall into a form of depression as a way of dealing with stress. However, I have a few concerns with the way this particular study was performed. The researchers used a group of volunteers and hospital staff as a control group for the experiment. These people will have had a certain education that makes them apt to taking and scoring well on the CAS and HDRS. Whether that is reflective of their levels of depression or anxiety may not be reliable. I think that the control group needed to be more representative of the normal population that those patients would live among, in normal society. It may be leaning towards the high-end doctors who have been taught not only how to deal with stress but how to teach others how to deal with stress.

Due to the complexity of pinning down oxytocin's function, I am concerned with just making a correlation based on depressed individuals. If a negative correlation exists between oxytocin and depression, then an injection of oxytocin should cause an individual to score happier (i.e., less depressed) on the DSM-IV. For that reason, the measures would be inversely applicable. Lower plasma oxytocin levels would mean more depression and higher oxytocin would mean less depression. Since this is such a complex

system, we cannot just conclude that oxytocin has this affect with just one of these sides. It could be that oxytocin indirectly affects depression and anxiety.

III. DISCUSSION

Discussion of Past Research

From this research, we are beginning to define some of the characteristics in human behavior that oxytocin can be attributed to. In most experiments, there is an indirect link between oxytocin and the behavior affected. This means that oxytocin can create a more manageable disposition for responding to angry ruminations, instead of oxytocin directly calming you down from anger.

From the research behind empathy, the study was left a bit inconclusive. However, there were hints in the research that an increase in oxytocin can cause a person to be empathetic. Since oxytocin is a hormone that affects many different systems in the body, it seems that these effects on human behavior are effects of having a better disposition. From taking perspective, sexual motivation followed in the search for how oxytocin affects behavior.

Similarly, as before in empathy, the results of the research show a positive correlation between oxytocin and increased sexual desire. However, it is likely through how oxytocin affects an individual's disposition. It is more likely for a relationship to be fruitful with sexual expression if the relationship is primed for psychological arousal through positive interactions. Therefore, if oxytocin helps make you a nicer and more easy-going person, then you are more likely to have positive interactions with your partner leading to more sex. Sex is a good start, but what happens when the relationship incorporates commitment? Couples are the basic building block of society and how does oxytocin affect our behavior in regards to pair-bonded relationships?

The research behind couples tested blood plasma oxytocin levels compared with relationship distress in women. What was interesting behind this research was that the women were affected by oxytocin while the men were not. However, the men were affected in the same manner to relationship distress by vasopressin, while the women were not. Again the oxytocin and vasopressin seemed to serve an evolutionarily essential role in pairing up partners to meet the need of vital nourishment and general safety. What would happen if individuals in a pair-bonded relationship have developed trust and then have to deal with trust betrayal?

In most human interactions, there is some form of trust betrayal that affects the individuals affected. Oxytocin plays a part in the way that individuals interpret the trust betrayal. The way that people are able to react to angry ruminations would be affected by the levels of oxytocin that the individual would have. Oxytocin would enable the person to more likely trust others when they were having interpersonal interactions. Whenever the participant was let down or betrayed, the participant would not tie a personal attribution to the letdown. Somehow (most likely through a predisposed disposition created by increased oxytocin), the participants were less likely to blame their interactional counterparts directly.

Stress can be buffered by any positive supportive environment, just as it can be aggravated by a negative environment. The just of the research states that oxytocin has a commonly studied receptor gene. When expressing a certain allele, these individuals will have deficits in certain pro-social behavior. This would mean that these individuals would be more predisposed to taking on more stress by the way that they interpret their own environment. Therefore, it is guided by a certain oxytocin receptor gene whether the

individual will be able to interpret their environment efficiently. Stress is a crucial factor in determining how a person reacts in their society. As chronic stress progresses, it could develop into anxiety.

The research about anxiety and its correlation with oxytocin showed that it was actually men who benefited more from high blood oxytocin levels. The research shows that women who reported higher attachment anxiety had higher levels of oxytocin. That is a negative correlation, which lead to the theory that the oxytocinergic system for women was becoming over-exacerbated. This would cause them to be creating more anxiety due to the dispositions created by high levels of oxytocin. High anxiety can cause more problems in the body, deterioration of health, and lacking strength for immune system to fight off illness. Moreover, high anxiety can lead to depression.

In the research, depression was correlated with lower levels of plasma oxytocin. From the study, the researchers concluded that oxytocin level had an effect of how overwhelmed an individual felt and how likely they are to fall into a form of depression to deal with stress. The depressed victims would have lower levels of oxytocin than their similar age controls.

Overall, this research attributes to the complexity that is wrapped around oxytocin. Over most of the studies it appeared as though oxytocin, as a hormone, would have an effect on the individual's disposition. From there, the individual's disposition would affect their behaviors.

Strengths and Limitations

Certain strengths have generated from the research of oxytocin. We have learned that oxytocin affects more than just the physiological processes wrapped around women's

pregnancies. By creating experiments and correlative readings between blood oxytocin levels and human behavior, we have begun to map out what oxytocin is, the bodily systems that it affects, and what behaviors it is able to indirectly influence.

Oxytocin only has very limited direct causation towards human behavior. For this reason studies have to really dissect human behavior to find constructs that may be affected by the hormone oxytocin. From these connections future research can begin to weave the deep intricacies that complicate the effects on human behavior that oxytocin has.

Implications for Future Research

Oxytocin has such a high complexity. Oxytocin affects the disposition of an individual, which from there can affect the behavior. This creates a problem when isolating the effects of oxytocin. There are studies that intra-nasally inject oxytocin directly into the body's systems and determine what kind of effects it takes. However, these types of experiments are too simplistic and only start to break down the complexity of how oxytocin affects human behavior.

For a more stable analysis of what effects oxytocin has on behavior, there needs to be more longitudinal studies. More than likely, the longitudinal studies will still be correlative but there can be more questions that are answered. One of the questions would be, can an individual train to have an increase of oxytocin, or response, by conditioning empathetic responses? There are certain times in our life that we develop more testosterone or estrogen. Longitudinal studies would also be able to differentiate a stronger correlation between a behavior and oxytocin. Also behind longitudinal studies, we could discover effects of oxytocin fluctuations and how that may influence behavior.

Implications for Theory

Overall, the effects of oxytocin on human behavior have a transitory step. Oxytocin generally affects the predisposition of the participant before testing the behavioral construct. Oxytocin conditions general attitude to be more temperamental and trusting towards others, and situations. Therefore instead of making someone less stressed as oxytocin levels increase, they are simply less likely to interpret common stressors as stressful stimuli.

Summary and Conclusion

Oxytocin has many physiological effects in the human body, such as the letdown reaction in nursing mothers. However, as a hormone, oxytocin also has many background effects on human behavior. Most of these behaviors are affected by a predisposition that the hormone can condition in an individual before they actually perform the behavioral construct under consideration.

From this research, the next step to further the understanding of oxytocin's potential effects on human behavior would be to monitor behavior in longitudinal studies. Due to the style of longitudinal studies, we can break down the behavioral constructs in individuals more in depth. With enough longitudinal studies, there will be a more accurate average of what oxytocin truly does in our systems with respect to human behavior.

REFERENCES

Bancroft, J. (2002). The medicalization of female sexual dysfunction: The need for caution. *Archives of Sexual Behavior, 31,* 451-455.

Caldwell, J. D., Johns, J. M., Faggin, B. M., Senger, M. A., & Penderson C. A. (1994). Infusion of an oxytocin antagonist into the medial preoptic area prior to progesterone inhibits sexual receptivity and increases rejection in female rats. *Hormonal Behavior, 28,* 288-302.

Carmichael, M. S., Humbert, R., Dixon, J., Palmisano, G., Greenleaf, W., & Davidson, J. M. (1987). Plasma oxytocin increases in the human sexual response. *Journal of Clinical Endocrinology and Metabolism, 64,* 27-31.

Carmichael, M. S., Warburton, V. L., Dixen, J., & Davidson, J. M. (1994). Relationships among cardiovascular, muscular, and oxytocin responses during human sexual activity. *Archives of Sexual Behavior, 23,* 59-79.

Carter, S. C. (1998). Neuroendocrine perspectives on social attachment and love. *Psychoneurendocrinology, 23,* 779-818.

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 Science United States of America, 108,* 19937–19942.

Fisher, H. (1999). *The first sex; the natural talents of women and how they are changing the world.* New York: Ballantine.

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

Hiller, J. (2005). Gender differences in sexual motivation. *Journal of Men's Health & Gender, 2*, 339-345.

Insel T. R. (1997). A neurobiological basis of social attachment. *American Journal of Psychiatry, 54*, 726-735.

Kiss, A., & Mikkelsen, J. (2005). Oxytocin--anatomy and functional assignments: A minireview. *Endocrine Regulations, 39,* 97-105.

Klackl, J., Pfundmair, M., Agroskin, D., & Jonas, E. (2013). Who is to blame? Oxytocin promotes nonpersonalistic attributions in response to a trust betrayal. *Biological Psychology, 92,* 387-394.

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

Lucas-Thompson, R. G., & Holman, E. (2013). Environmental stress, oxytocin receptor gene (OXTR) polymorphism, and mental health following collective stress. *Hormones and Behavior, 63,* 615-624.

Murphy, M. R., Seckel, J. R., Burton, S., Checkley, S. A., & Lightman, S. L. (1987). Changes in oxytocin and vasopressin secretion during sexual activity in men. *Journal of Clinical Endocrinology and Metabolism, 68,* 738-741.

Opacka-Juffry, J., & Mohiyeddini, C. (2012). Experience of stress in childhood negatively correlates with plasma oxytocin concentration in adult men. *Stress, 15,* 1-10.

Ozsoy, S., Esel, E., & Kula, M. (2009). Serum oxytocin levels in patients with depression and the effects of gender and antidepressant treatment. *Psychiatry Research, 169,* 249-252.

Panksepp, J. (1998). *Affective neuroscience: The foundation of human and animal emotions.* New York: Oxford University Press.

Riley, A., & Riley, F. (2000). Controlled studies on women presenting with sexual drive disorders 1. Endocrine status. *Journal of Sex, and Marital Therapy, 26,* 269-283.

Scantamburlo, G., Hansenne, M., Fuchs, S., Pitchot, W., Marechal, P., Pequeux, C., Ansseau, M., & Legros, J. J. (2007). Plasma oxytocin levels and anxiety in patients with major depression. *Psychoneuroendocrinology, 32,* 407-410.

Smith, A. S., & Wang, Z. (2012). Salubrious effects of oxytocin on social stress-induced deficits. *Hormonal Behavior, 61,* 320-330.

Taylor, S. E. (2006). Tend and befriend: Biobehavioral bases of affiliation under stress. *Current Directions in Psychological Science, 15,* 273-277.

Taylor, S. E., Saphire-Bernstein, S., & Seeman, T. E. (2010). Are plasma oxytocin in women and plasma vasopressin in men biomarkers of distressed pair-bond relationships? *Psychological Science, 21,* 3-7.

Theodoridou, A., Rowe, A. C., & Mohr, C. (2013). Men perform comparably to women in a perspective taking task after administration of intranasal oxytocin but not after placebo. *Frontiers In Human Neuroscience, 7,* 1-11.

Uvnas-Moberg K. (1998). Oxytocin may mediate the benefits of positive social interaction and emotions. *Psychoneuroendocrinology, 23,* 819-35.

van Londen, L., Goekoop, J. G., van Kempen, G. M., Frankhuijzen-Sierevogel, A. C., Wiegant, V. M., van der Velde, E. A., & De Wied, D. (1997). Plasma levels of arginine vasopressin elevated in patients with major depression. *Neuropsychopharmacology, 17,* 284-292.

Weisman, O., Zagoory-Sharon, O., Schneiderman, I., Gordon, I., & Feldman, R. (2013). Plasma oxytocin distributions in a large cohort of women and men and their gender-specific associations with anxiety. *Psychoneuroendocrinology, 38,* 694-701.

Zetzsche, T., Frasch, A., Jirikowski, G., Murck, H., Steiger, A. (1996). Nocturnal oxytocin secretion is reduced in major depression. *Biological Psychiatry, 39,* 584.

DEFINITIONS

Confederate—An actor placed in the study by the researcher to manipulate the study from the inside.

Social desirability bias—The bias in which participants respond or act in a manner which they think they should, not as they truly would.

Deception—Using a front in an experiment in order to truly test something you are interested in. Participants are debriefed by the end of the study, where they are informed of what the test was really finding.

OXT—Abbreviation for oxytocin.

AVP—Abbreviation for Arginine Vasopressin.

DSM-IV—Diagnostic and Statistical Manual of Mental Disorders, 4^{th} edition. The current diagnostic and statistical manual of the American Psychiatric Association that classifies, defines, and describes mental disorders.

HDRS—Hamilton Depression Rating Scale.

CAS—Clinical Anxiety Scale.

ECT—Electroconvulsive Therapy, which is used to induce seizures into the body to provide the patient with psychiatric relief. ECT is usually used with major depressive disorder, catatonia, mania, and schizophrenia.

IU—International Unit for measuring doses.

Rumination—The compulsively focused attention on the symptoms of one's distress, and on its possible causes and consequences, as opposed to its solutions.