The Effect of Oxytocin on Interpersonal Adaptation in Insecurely Attached Individuals

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Abstract

Oxytocin, acclaimed as the "love hormone," is intimately associated with attachment. Previous research has demonstrated that oxytocin from different sources exerts differential effects on the interpersonal adaptability of insecurely attached individuals, primarily manifested as: lower endogenous oxytocin levels are associated with poorer interpersonal adaptability in insecurely attached individuals; exogenous oxytocin enhances interpersonal adaptability in attachment-avoidant individuals but reduces it in those with high attachment anxiety; and A and G alleles are implicated in the interpersonal adaptability of insecurely attached individuals. These effects have been explained through attachment theory and the social salience hypothesis, with defensive exclusion in insecurely attached individuals, environmental factors, and individual differences moderating the effects of oxytocin. Future research should compare differences in the relationship between oxytocin receptor genes and interpersonal adaptability in insecurely attached individuals, address gender differences in how oxytocin affects interpersonal adaptability in this population, and investigate the effects of oxytocin on interpersonal adaptability during actual interpersonal interactions to enhance the ecological validity of oxytocin research.

Full Text

Effects of Oxytocin on Interpersonal Adaptability Among Insecurely Attached Individuals

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Abstract

Oxytocin, known as the "hormone of love," is closely associated with attachment. Previous studies have demonstrated that oxytocin from different sources exerts differential effects on the interpersonal adaptability of insecurely attached individuals. Specifically, lower endogenous oxytocin levels correlate with poorer interpersonal adaptability among insecurely attached individuals. Exogenous oxytocin enhances interpersonal adaptability in avoidantly attached individuals but reduces it in those with high attachment anxiety. Additionally, A and G alleles are associated with interpersonal adaptability in insecurely attached individuals. These effects have been explained through attachment theory and the social salience hypothesis, with defensive exclusion, environmental factors, and individual differences moderating oxytocin's effects. Future research should compare differences in how oxytocin receptor genes relate to interpersonal adaptability among insecurely attached individuals, examine gender differences in oxytocin' s effects on interpersonal adaptability, and investigate oxytocin' s impact on insecurely attached individuals' interpersonal adaptability during actual interpersonal interactions to enhance ecological validity.

Keywords: oxytocin; insecure attachment; interpersonal adaptability; social salience hypothesis; defensive exclusion

Interpersonal adaptability refers to the personality characteristics that individuals possess and exhibit during interpersonal adaptation processes, also known as interpersonal relationship characteristics (Chen Jianwen & Huang Xiting, 2004). Attachment is one of the most reliable predictors of interpersonal relationships. Li Cain (2006) proposed that early attachment relationships become internalized as individuals' internal working models of self and others, subsequently forming relatively stable interpersonal expectations as well as emotional and behavioral styles. Compared with securely attached individuals who hold positive attitudes toward others and are more capable of trust, understanding, and empathy (Dykas & Cassidy, 2011), insecurely attached individuals show less positive expectations regarding intimacy, dependence, and trust in interpersonal relationships (Rowe & Carnelley, 2003). Insecure attachment refers to psychological representations formed during interactions with unresponsive or inconsistently responsive attachment figures who typically fail to provide protection, support, and security (Ein-Dor, Mikulincer, & Shaver, 2011). Bartholomew and Horowitz (1991) identified insecure attachment as comprising attachment anxiety and attachment avoidance. Attachment anxiety originates from early interactions with caregivers and is characterized by worry, hypervigilance to attachment-related cues, and chronic feelings of unmet attachment needs. Attachment avoidance stems from early caregiver rejection and neglect, characterized by excessive self-focus and rejection of others—namely, self-centeredness and indifference toward others. Sadikaj, Moskowitz, and Zuroff (2011) found that higher attachment anxiety scores make individuals more susceptible to others' negative behaviors in interpersonal interactions, triggering more negative emotional experiences. Higher attachment avoidance scores result in emotions being less influenced by

cognitive processing of others' behaviors, though their defensive suppression may more likely lead to interpersonal difficulties.

Oxytocin modulates brain activity related to social cognition. Meyer-Lindenberg, Domes, Kirsch, and Heinrichs (2011) consider it an important neuromodulator in interpersonal perception and communication, as well as a neurobiological factor associated with attachment that plays a significant role in attachment processes. Carter and Sue (2017) suggest that oxytocin has positive effects on attachment, and that adaptive changes in the oxytocin system resulting from early life experiences in humans and other mammals may alter brain receptors and their functions, thereby facilitating the formation of attachment capacity. Current research on oxytocin and attachment shows inconsistent findings. Despite being called the "hormone of love," oxytocin does not always positively affect the interpersonal adaptability of insecurely attached individuals. This inconsistency may relate to oxytocin' s source, as oxytocin from different sources produces different effects on interpersonal adaptability in insecurely attached individuals. Based on source, oxytocin can be divided into endogenous and exogenous forms. Research indicates that both endogenous and exogenous oxytocin require involvement of oxytocin receptor genes to influence social behavior (Wu Nan & Su Yanjie, 2012). Previous researchers have used the social salience hypothesis to explain oxytocin' s effects on social behavior (Jin Yuchang & Wu Jing, 2016; Zhang Xukai, Yin Hang, Li Peng, & Li Hong, 2018). Additionally, according to Bowlby' s attachment theory, the concept of defensive exclusion in insecurely attached individuals may help explain this issue (Bowlby, 1980). Based on this, the present article examines how oxytocin from different sources affects interpersonal adaptability in insecurely attached individuals, using attachment theory and the social salience hypothesis to explore the underlying mechanisms.

1. Relationship Between Endogenous Oxytocin Levels and Interpersonal Adaptability in Insecurely Attached Individuals

Endogenous oxytocin refers to oxytocin contained in human blood, urine, saliva, and cerebrospinal fluid. Studies examining endogenous oxytocin' s effects on social behavior typically use radioimmunoassays (RIA) and enzyme immunoassay (EIA) to measure oxytocin levels in blood and saliva, establishing correlations with specific social behaviors to determine endogenous oxytocin' s impact on interpersonal adaptability in insecurely attached individuals.

1.1 Lower Endogenous Oxytocin Levels Correlate with Poorer Interpersonal Adaptability in Avoidantly Attached Individuals Research demonstrates that avoidantly attached individuals show poorer interpersonal adaptability when endogenous oxytocin levels are low. Müller et al. (2018) found that plasma oxytocin levels positively correlate with adult attachment, with lower plasma oxytocin levels predicting insecure attachment representations in adults. Under conditions of low endogenous oxytocin, insecurely attached in-

dividuals develop fear and avoidance of social situations, resulting in poorer interpersonal adaptability. Additionally, studies have found that compared to securely attached mothers, avoidantly attached mothers show significantly reduced plasma oxytocin levels after interacting with their children. Since oxytocin responses are associated with activation of the hypothalamus and ventral striatum, activation in these regions also diminishes. Reduced plasma oxytocin levels, accompanied by neglectful behavior from avoidantly attached mothers, help explain why avoidantly attached mothers show less activation in mesocorticolimbic dopamine reward regions when viewing pictures of their infants (Strathearn, 2011). Sabrina et al. (2016) found that compared to securely attached mothers, insecurely attached mothers showed increased plasma oxytocin levels after viewing the Adult Attachment Projective Picture System (AAP), suggesting that AAP serves not only as an assessment tool for attachment classification but also creates a safe, positive atmosphere that activates mothers' specific physiological response patterns and increases endogenous oxytocin concentrations. This study provides converging evidence that lower endogenous oxytocin levels correlate with poorer interpersonal adaptability. Research also indicates that elevated parental endogenous oxytocin levels positively correlate with parent-child social engagement and emotional synchrony (Feldman, Gordon, & Zagoory-Sharon, 2011), demonstrating that higher endogenous oxytocin levels enhance interpersonal adaptability, whereas lower levels predict poorer adaptability. If higher endogenous oxytocin levels reflect greater social sensitivity, then higher oxytocin concentrations lead individuals to attend more to safe or positive social cues in the environment, resulting in more prosocial behavior and stronger interpersonal sensitivity. However, they may experience distress when social needs are unmet, subsequently reducing prosocial behavior (Taylor, 2006).

1.2 Lower Endogenous Oxytocin Levels Correlate with Poorer Interpersonal Adaptability in Anxiously Attached Individuals Research shows that lower endogenous oxytocin concentrations correlate with poorer interpersonal adaptability in anxiously attached individuals. Haas, Filkowski, Cochran, Denison, and Smith (2016) found that oxytocin DNA methylation extracted from saliva significantly correlated with self-reported attachment style. Under conditions of higher oxytocin DNA methylation and reduced oxytocin secretion, participants showed higher attachment anxiety scores and weaker ability to recognize emotional facial expressions, indicating that lower endogenous oxytocin concentrations correspond to higher attachment anxiety. Higher attachment anxiety scores make individuals more vulnerable to others' negative behaviors in interpersonal interactions, triggering more negative emotional experiences and consequently poorer interpersonal adaptability. Researchers also observed that higher oxytocin DNA methylation correlated with reduced neural activity in brain regions important for social cognitive function, including the right superior temporal sulcus, right fusiform gyrus, and right inferior frontal gyrus. Ebner, Lin, Muradoglu, Weir, and Connelly (2018) found that lower

oxytocin receptor gene methylation and higher endogenous oxytocin levels correlated with reduced attachment anxiety in young adults. However, Marazziti et al. (2006) found that in romantic attachment, plasma oxytocin levels positively correlated with attachment anxiety scores—higher plasma oxytocin corresponded to higher attachment anxiety. Some researchers interpret this as oxytocin having anxiolytic effects (Insel, 2001), requiring increased plasma oxytocin concentrations to alleviate attachment anxiety in romantic relationships. Furthermore, attachment style affects endogenous oxytocin secretion. Pierrehumbert et al. (2012) found that compared to securely attached individuals who have lower subjective stress and higher plasma oxytocin levels, anxiously attached individuals show moderate stress levels but lower plasma oxytocin levels. Therefore, researchers propose that endogenous oxytocin secretion may not be directly linked to attachment system activation but may relate to the reward aspects rather than motivational aspects of the attachment system, consistent with Bowlby' s attachment theory describing the adaptive function of the attachment system.

In summary, endogenous oxytocin in insecurely attached individuals is closely linked to their interpersonal adaptability. On one hand, lower endogenous oxytocin levels correlate with poorer interpersonal adaptability in avoidantly attached individuals. When avoidantly attached individuals are in negative environments, lower oxytocin concentrations cause them to focus more on threatening cues, resulting in poorer interpersonal adaptability. On the other hand, lower endogenous oxytocin levels correlate with poorer interpersonal adaptability in anxiously attached individuals. Under conditions of low plasma oxytocin, anxiously attached individuals in threatening environments are more susceptible to negative environmental factors, which increases attachment anxiety and leads to more negative emotional experiences and negative cognitions about others during interpersonal interactions, manifesting as poorer interpersonal adaptability.

2. Effects of Exogenous Oxytocin on Interpersonal Adaptability in Insecurely Attached Individuals

Research investigating exogenous oxytocin' s effects on interpersonal adaptability in insecurely attached individuals predominantly employs intranasal oxytocin administration. This method helps us better understand how oxytocin crosses the blood-brain barrier to act on limbic systems closely related to social behavior. By artificially manipulating oxytocin levels to induce changes in social behavior and brain activity, this approach aligns with the principles of the priming hypothesis (Ludwig & Leng, 2006). Researchers have therefore used this method to examine exogenous oxytocin' s effects on interpersonal adaptability in insecurely attached individuals.

2.1 Exogenous Oxytocin Enhances Interpersonal Adaptability in Avoidantly Attached Individuals Research demonstrates that intranasal

oxytocin administration enhances interpersonal adaptability in avoidantly attached individuals. For example, Buchheim et al. (2009) found that compared to placebo conditions, most insecurely attached male participants selected secure attachment phrases under exogenous oxytocin conditions, suggesting that oxytocin induces temporary psychological changes that allow participants to experience attachment-related comfort and security. This result aligns with neuroimaging findings in healthy participants showing that brain regions activated when viewing pictures of close others significantly overlap with areas of high oxytocin receptor density, such as the striatum (Bartels & Zeki, 2004). De Dreu (2012) examined how intranasal oxytocin affects trust and cooperation behaviors in individuals with different attachment styles, finding that exogenous oxytocin increased trust and cooperation in insecurely attached individuals, with more pronounced effects in avoidantly attached individuals. Fang, Hoge, Heinrichs, and Hofmann (2014) investigated whether attachment style in individuals with social anxiety disorder moderated exogenous oxytocin' s effects on social behavior and cognition during social rejection, finding that compared to placebo, low-avoidance individuals showed more social identification and cooperative behavior after exogenous oxytocin administration. Bartz et al. (2015) also found that compared to placebo, avoidantly attached male participants became more communal after exogenous oxytocin, describing themselves as more "kind, warm, gentle," indicating that exogenous oxytocin motivated avoidantly attached individuals to begin attending to, caring for, and showing concern for others. However, results from single-dose intranasal oxytocin may be incidental, prompting subsequent research to investigate long-term effects. Bernaerts et al. (2017) found that long-term exogenous oxytocin treatment was most effective for individuals showing insecure peer attachment. After two weeks of intranasal oxytocin, insecurely attached male participants showed reduced attachment avoidance and enhanced peer attachment. These results indicate that two weeks of oxytocin treatment reduced participants' tendencies to avoid closeness or trust with others. The above findings reveal that individuals who tend to be overly self-focused and reduce closeness with others are most likely to benefit from exogenous oxytocin treatment. Exogenous oxytocin influences avoidantly attached individuals by increasing reciprocal cooperative behavior, promoting trust in others, and thereby enhancing their interpersonal adaptability.

2.2 Exogenous Oxytocin Reduces Interpersonal Adaptability in Highly Anxiously Attached Individuals Research indicates that exogenous oxytocin administration reduces interpersonal adaptability in highly anxiously attached individuals. Kosfeld, Heinrichs, Zak, Fischbacher, and Fehr (2005) pioneered the use of intranasal oxytocin, finding that individuals showed increased investment behavior and greater trust in others after exogenous oxytocin administration, thereby demonstrating that exogenous oxytocin can influence trust behavior. Bartz, Simeon, Hamilton, Crystal, and Braun et al. (2011) examined intranasal oxytocin' s effects on trust and cooperation

in healthy adult males and individuals with borderline personality disorder (BPD, characterized by intense interpersonal relationships featuring desperate avoidance of abandonment). They found that while low-anxiety individuals showed no significant differences in cooperative and trust behaviors between oxytocin and placebo conditions, highly anxiously attached individuals who were sensitive to rejection showed significantly reduced cooperation and trust after exogenous oxytocin administration. De Dreu (2012) found that highly anxiously attached individuals did not show the same results after intranasal oxytocin as highly avoidant individuals (such as increased trust and cooperation or reduced aversion to betrayal). This finding aligns with previous research showing that after intranasal oxytocin, low-anxiety individuals recalled more positive memories of maternal care and closeness during childhood, whereas highly anxious individuals reported less maternal care and more distant parent-child relationships (Bartz et al., 2010). Additionally, Bartz et al. (2015) found that highly anxiously attached male participants showed reduced independence, self-confidence, self-esteem, and well-being after receiving intranasal oxytocin. Accumulating evidence suggests that responses to exogenous oxytocin are moderated by early life experiences, including whether individuals perceive security (Carter & Sue, 2017). These studies indicate that oxytocin is not a universal remedy; it may hinder trust and cooperation depending on the presence of interpersonal insecurity, with antisocial effects of oxytocin being more pronounced in individuals with vulnerable interpersonal relationships (especially those with group motivations but lacking self-awareness).

In summary, exogenous oxytocin' s effects on interpersonal adaptability in insecurely attached individuals include two main aspects. On one hand, exogenous oxytocin enhances interpersonal adaptability in avoidantly attached individuals. For socially maladaptive avoidant individuals, exogenous oxytocin makes them more likely to perceive others as cooperative or friendly, thereby increasing trust and cooperative behavior during interpersonal interactions and improving interpersonal adaptability. On the other hand, exogenous oxytocin reduces interpersonal adaptability in highly anxiously attached individuals. For those intensely focused on interpersonal intimacy, exogenous oxytocin exacerbates their interpersonal insecurity, thereby reducing their interpersonal adaptability. The divergent effects of exogenous oxytocin on avoidantly versus anxiously attached individuals may arise for several reasons. First, oxytocin influences interpersonal adaptability in insecurely attached individuals in a context-dependent manner, producing either positive or negative effects. Second, oxytocin' s effects are not consistent across all individuals but vary according to gender, attachment type, and psychopathology (Shamay-Tsoory & Abu-Akel, 2015). Finally, differences in the endogenous oxytocin system may moderate exogenous oxytocin' s effects on interpersonal adaptability in insecurely attached individuals, though no current studies have measured participants' baseline endogenous oxytocin levels before exogenous oxytocin administration.

3. Relationship Between Oxytocin Receptor Genes and Interpersonal Adaptability in Insecurely Attached Individuals

Research has shown that the oxytocin receptor gene is associated with human social abilities. Examining oxytocin receptor gene polymorphisms through genotyping and correlating them with specific social behaviors helps analyze how oxytocin receptor genes influence social behavior. The human oxytocin receptor gene is located on chromosome 3p25 and has been confirmed to have considerable nucleotide polymorphisms. At different SNP loci, there are different genotypes (Lucht et al., 2009). For example, at loci such as rs53576, rs7632287, rs237887, and rs2254298, genotypes manifest as AA, AG, and GG types. These three different allele patterns are associated with different psychological and behavioral outcomes. However, many previous studies have focused more on examining A and G alleles. Therefore, this article separately explores the relationships between A alleles, G alleles, and interpersonal adaptability in insecurely attached individuals to determine the genetic-level effects of oxytocin receptor genes.

3.1 A Allele and Interpersonal Adaptability in Insecurely Attached Individuals Tost et al. (2010) found that individuals carrying the A allele at OXTR rs53576 show lower social competence and empathy, express fewer prosocial and intimate nonverbal cues, and exhibit higher physiological and subjective stress reactivity. Therefore, the A allele is sometimes called the "risk allele." Chen and Johnson (2012) used molecular genetics methods to find that females carrying the A allele at OXTR rs2254298 showed higher attachment anxiety scores. Higher attachment anxiety scores correlate with poorer interpersonal adaptability, possibly because the hyperactivating strategies used by anxiously attached individuals lead them to exaggerate environmental threats during interpersonal interactions, thereby reducing interpersonal adaptability. However, this result was not found in males. According to the social salience hypothesis, oxytocin receptor gene effects on interpersonal adaptability in insecurely attached individuals are moderated by individual differences. Shamay-Tsoory and Abu-Akel (2015) suggest that gender influences individuals' attention to social cues, and that men and women may be subject to different social norms when interpreting and reporting difficulties in social relationships. Notzon et al. (2015) used a gene-environment interaction approach to explore the relationship between attachment style and oxytocin receptor gene variation, finding that insecurely attached individuals carrying the A allele at OXTR rs53576 experienced stronger negative effects of social anxiety. Research examining how oxytocin receptor genes and attachment may interact to predict individuals' assessment of risks in disclosing private information and their intimacy with romantic partners found that, compared to securely attached individuals, oxytocin receptor genes had greater impact on insecurely attached individuals' risk assessment and intimacy. Insecurely attached individuals carrying the A allele at OXTR rs53576 were more likely to perceive risks in disclosing private information to their partners and reported lower intimacy with partners. Thus, the A allele at OXTR rs53576 is associated with poorer interpersonal adapt-

ability in insecurely attached individuals (Denes, 2015). Furthermore, research on veterans found that compared to securely attached individuals, insecurely attached individuals carrying the A allele at OXTR rs53576 had higher risk for post-traumatic stress disorder (PTSD), again confirming that the A allele at OXTR rs53576 is associated with poorer interpersonal adaptability in insecurely attached individuals (Sippel et al., 2017).

3.2 G Allele and Interpersonal Adaptability in Insecurely Attached Individuals Saphire-Bernstein, Way, Kim, Sherman, and Taylor (2011) found that individuals carrying the G allele at OXTR rs53576 show greater optimism, mastery, and self-esteem, believing they can determine their own behavior and produce desired outcomes. Compared to mothers not carrying the G allele, mothers carrying the G allele at OXTR rs53576 who grew up in low-maltreatment environments showed warmer responses to their children (Klahr, Klump, & Burt, 2015). Securely attached individuals carrying the G allele at OXTR rs53576 reported higher marital satisfaction (Monin, Goktas, Kershaw, & DeWan, 2019), though other studies indicate that adolescents with maltreatment histories who carry the G allele at OXTR rs53576 receive less social support (Hostinar, Cicchetti, & Rogosch, 2014). Reviewing recent attachment literature, Ludmer et al. (2018) propose that the G allele at OXTR rs53576 is a more plastic allele that moderates the relationship between maternal childhood maltreatment history and disorganized mother-infant attachment. Results showed that compared to mothers carrying fewer G alleles, mothers carrying more G alleles at OXTR rs53576 showed stronger predictive power of childhood maltreatment history for insecure attachment representations. Since insecurely attached individuals typically show poorer interpersonal functioning, researchers suggest that the G allele at OXTR rs53576 is associated with poorer interpersonal adaptability in insecurely attached individuals. Previous research confirms this view, such as findings that depressed patients carrying the G allele at OXTR rs53576 are associated with insecure attachment styles (Costa et al., 2009). Bradley et al. (2011) found that individuals with childhood maltreatment experiences who are carriers of the G allele at OXTR rs53576 show significantly increased likelihood of insecure attachment. Floyd and Denes (2015) used a gene-environment interaction approach to find that compared to individuals with higher secure attachment, the G allele at OXTR rs53576 had stronger effects on emotional communication in individuals with lower secure attachment. Insecurely attached individuals carrying the G allele show interpersonal adaptability strongly influenced by their attention to environmental social cues. When insecure individuals are in negative environments, those carrying the G allele pay more attention to threatening stimuli, resulting in poorer interpersonal adaptability.

In summary, these studies demonstrate that the oxytocin receptor gene is associated with human social abilities and closely linked to interpersonal adaptability in insecurely attached individuals. On one hand, the A allele is associated with interpersonal adaptability in insecurely attached individuals during interper-

sonal interactions. The A allele is called the "risk allele," and insecurely attached individuals carrying the A allele in negative environments are more susceptible to negative environmental cues, showing poorer interpersonal adaptability. On the other hand, the G allele is also associated with interpersonal adaptability in insecurely attached individuals during interpersonal interactions. Research has found that individuals carrying the G allele at OXTR rs53576 have lower plasma oxytocin levels (Moons, Way, & Taylor, 2014). Therefore, lower plasma oxytocin levels may cause insecurely attached individuals carrying the G allele to pay more attention to threatening stimuli, resulting in poorer interpersonal adaptability.

4. Internal Mechanisms Through Which Oxytocin Affects Interpersonal Adaptability in Insecurely Attached Individuals

In summary, endogenous oxytocin, exogenous oxytocin, and oxytocin receptor genes all influence interpersonal adaptability in insecurely attached individuals. These effects manifest as poorer interpersonal adaptability with lower endogenous oxytocin levels, enhanced adaptability in avoidantly attached individuals but reduced adaptability in highly anxiously attached individuals after exogenous oxytocin administration, and associations between A and G alleles and interpersonal adaptability. However, the mechanisms through which oxytocin affects interpersonal adaptability in insecure individuals remain unclear. According to Bowlby' s attachment theory, the concept of defensive exclusion in insecurely attached individuals may provide insight into understanding this issue. Additionally, the social salience hypothesis suggests that environmental factors and individual differences moderate oxytocin' s social effects. Based on this, this article further clarifies the internal mechanisms of oxytocin' s effects on interpersonal adaptability in insecurely attached individuals from the perspectives of attachment theory and the social salience hypothesis.

4.1 Effects of Defensive Exclusion in Insecurely Attached Individuals Bowlby proposed that internal working models of attachment influence how individuals acquire, organize, and manipulate attachment-related social information. When individuals encounter attachment-related information that previously caused distress, their internal working models provide defensive functions that distance them from this negative information. Bowlby used the term "defensive exclusion" when referring to information processing that prevents potentially painful information from entering consciousness, considering defensive exclusion a characteristic of insecurely attached individuals. Deactivation and cognitive disconnection from situational responses are two forms of defensive exclusion (Bowlby, 1980).

One form of defensive exclusion is deactivation, which occurs when internal working models partially or completely function to deactivate information by diverting attention away from attachment-related information to avoid deep processing (Bowlby, 1980). Deactivation can be linked to the deactivating strategies

used by avoidantly attached individuals. When caregivers consistently reject children' s needs for care and protection, attachment avoidance develops. To avoid the pain of neglect, avoidantly attached individuals typically reduce dependence by limiting intimate behaviors and refusing to seek support, using deactivating strategies to maintain a sense of self-control (Mikulincer & Shaver, 2007). Under conditions of low endogenous oxytocin, avoidantly attached individuals show poorer interpersonal adaptability, possibly because their interpersonal experiences involve negative interactions, causing their internal working models to divert attention from painful or negative information that cannot be completely excluded from consciousness, resulting in poorer interpersonal adaptability. After exogenous oxytocin administration, interpersonal adaptability in avoidantly attached individuals is enhanced. Since avoidantly attached individuals have positive self-models and negative other-models, exogenous oxytocin may alter their negative perceptions of others and change their sense of trust and dependence, thereby enhancing their interpersonal adaptability.

Another form of defensive exclusion is cognitive disconnection from situational responses, which involves diverting attention from the true source of pain and mistakenly identifying other individuals (including the self) or situations as the true source of pain (Bowlby, 1980). Cognitive disconnection from situational responses can be linked to the hyperactivating strategies of anxiously attached individuals. Due to inconsistent protection and responsiveness from caregivers in early life, anxiously attached individuals experience increased helplessness and vulnerability after rejection. Therefore, they typically maintain high sensitivity to threatening stimuli, exaggerating threat cues to seek attention (Mikulincer & Shaver, 2007). Under conditions of low endogenous oxytocin, anxiously attached individuals show poorer interpersonal adaptability, possibly because they have negative self-models and positive other-models, typically believing themselves unworthy of others' love. Therefore, under low endogenous oxytocin conditions, they perceive themselves as the true source of pain, demonstrating poorer interpersonal adaptability. After exogenous oxytocin administration, interpersonal adaptability in highly anxiously attached individuals is reduced, but no significant effect is observed in low-anxiety individuals. This may be because exogenous oxytocin is threatening to those with strong lack of self-awareness (highly anxiously attached individuals), exacerbating their personal and interpersonal vulnerability.

4.2 Moderating Effects of Environmental Factors and Individual Differences The social salience hypothesis proposes that oxytocin increases attention to social cues depending on environmental factors and individual differences (Bartz, Zaki, Bolger, & Ochsner, 2011; Shamay-Tsoory & Abu-Akel, 2015). Specifically, when individuals are in safe or positive environments, oxytocin increases attention to positive social cues, thereby increasing prosociality. Conversely, when individuals are in competitive or uncertain environments, oxytocin increases attention to negative social cues, reducing prosociality. Stable individual characteristics are primarily reflected in factors such as attachment

style and gender.

Oxytocin influences social behavior and cognition in a context-dependent manner, producing either positive or negative effects. For example, research shows that oxytocin's effects on social memory are not limited to negative interactions—it enhances fear after negative interactions but reduces fear after positive interactions (Guzman et al., 2014). Under conditions of low endogenous oxytocin, both avoidantly and anxiously attached individuals show poorer interpersonal adaptability, possibly because low endogenous oxytocin causes insecurely attached individuals to perceive themselves as being in threatening or stressful environments, leading them to focus more on negative environmental cues. Bartz, Zaki, Bolger, and Ochsner (2011) propose based on the social salience hypothesis that endogenous oxytocin may be a biological marker sensitive to social cues, with lower endogenous oxytocin concentrations typically associated with psychiatric disorders and poorer social cognitive performance, explaining why insecurely attached individuals show poorer interpersonal adaptability under low endogenous oxytocin conditions. After exogenous oxytocin administration, interpersonal adaptability is enhanced in avoidantly attached individuals but reduced in highly anxiously attached individuals. Since oxytocin has group-motivating effects that elicit care, attention, and concern for others (Bartz et al., 2015), avoidantly attached individuals increase attention to friendly or positive social cues after oxytocin administration and perceive others as trustworthy, thereby enhancing their interpersonal adaptability. Similarly, exogenous oxytocin also produces positive effects in individuals who are less adaptive at baseline (such as low-anxiety individuals). However, highly anxiously attached individuals increase attention to threat cues, which may trigger high levels of tension and anxiety, causing them to respond to this vulnerability through defensive self-protection or aggression toward others (Bartz, 2016). In such cases, exogenous oxytocin may have negative effects, reducing their interpersonal adaptability.

Oxytocin also influences social behavior and cognition in an individual-difference-dependent manner, producing either positive or negative effects. Although most oxytocin research has used male participants, studies show that oxytocin produces different effects in men and women. For example, Scheele et al. (2014) found that men made more selfish decisions after exogenous oxytocin administration, while women showed greater concern for others' interests and increased altruistic tendencies. Research indicates that exogenous oxytocin increases brain activity in men but reduces neural activation responses in women (Rilling et al., 2014). Previous studies on exogenous oxytocin' s effects on interpersonal adaptability in insecurely attached individuals have predominantly used male participants because earlier research found that estrogen in women affects oxytocin and its receptor genes (Choleris, Devidze, Kavaliers, & Pfaff, 2008). Therefore, whether results regarding exogenous oxytocin' s effects on interpersonal adaptability in insecurely attached individuals can be generalized to female participants requires extensive future research. Additionally, attachment style influences oxytocin' s social effects, with research showing that lower endogenous oxytocin levels correlate with

poorer interpersonal adaptability in both avoidantly and anxiously attached individuals, while exogenous oxytocin enhances adaptability in avoidantly attached individuals but reduces it in highly anxiously attached individuals.

5. Summary and Future Directions

In summary, this article examined how oxytocin from different sources affects interpersonal adaptability in insecurely attached individuals. Specifically, lower endogenous oxytocin levels correlate with poorer interpersonal adaptability in both avoidantly and anxiously attached individuals. Exogenous oxytocin enhances interpersonal adaptability in avoidantly attached individuals but reduces it in highly anxiously attached individuals. A and G alleles are associated with interpersonal adaptability in insecurely attached individuals. Building on previous research, this article used attachment theory and the social salience hypothesis to explain these effects and explore potential mechanisms. Both endogenous and exogenous oxytocin, as well as oxytocin receptor genes, influence interpersonal adaptability in insecurely attached individuals. Therefore, we cannot draw conclusions about oxytocin' s effects on interpersonal adaptability from any single aspect alone. We should consider that endogenous oxytocin, exogenous oxytocin, and oxytocin receptor genes are closely interconnected. Endogenous oxytocin may moderate social responses to exogenous oxytocin and oxytocin receptor genes, and both endogenous and exogenous oxytocin require oxytocin receptor gene involvement to influence social behavior. Future research should consider the effects of all three factors to obtain more comprehensive and integrated results. Although research on oxytocin' s effects on interpersonal adaptability in insecurely attached individuals has yielded many findings, several issues require further investigation.

5.1 Comparing Differences in How Oxytocin Receptor Genes Relate to Interpersonal Adaptability in Insecurely Attached Individuals Future research should compare differences in how oxytocin receptor genes relate to interpersonal adaptability in avoidantly versus anxiously attached individuals. Previous studies suggest no relationship between attachment anxiety or avoidance and oxytocin receptor genes (Gillath, Mccall, Shaver, & Blascovich, 2008). However, other research demonstrates that females carrying the C allele at OXTR rs4813625 and the A allele at OXTR rs2254298 show higher attachment anxiety (Chen & Johnson, 2012; Love et al., 2012). Ein-Dor, Verbeke, Mokry, and Vrtička (2018) found significant and specific relationships between attachment avoidance and oxytocin receptor genes, with higher oxytocin receptor gene methylation correlating with higher attachment avoidance scores compared to other attachment styles. Current research has focused more on separate effects of endogenous and exogenous oxytocin on anxiously and avoidantly attached individuals, while literature on oxytocin receptor genes' effects on interpersonal adaptability in these groups is very limited. However, since both endogenous and exogenous oxytocin act on oxytocin receptor genes to influence social behavior, research on oxytocin receptor genes and their re-

lationship to interpersonal adaptability in avoidantly and anxiously attached individuals is essential. Additionally, Sippel et al. (2017) suggest that genetic risk for social dysfunction at OXTR rs53576 may translate into a neural mechanism that causes individuals to negatively evaluate social stimuli, impairing the stress-buffering function of social support and leading them to view relationships as threatening, unstable, and untrustworthy. Since the principle of exogenous oxytocin administration is similar to the priming hypothesis (Ludwig & Leng, 2006), future research could consider combining oxytocin treatment with psychological interventions to better improve interpersonal adaptability in insecurely attached individuals, especially for highly anxiously attached individuals. Since uncontrolled oxytocin treatment may enhance the salience of negative interactions, chronic, routine oxytocin treatment without guaranteed positive social experiences may not be optimal, as oxytocin produces different effects in different environments and populations. Therefore, oxytocin interventions require careful consideration of environmental factors and individual differences.

5.2 Examining Gender Differences in Oxytocin' s Effects on Interpersonal Adaptability in Insecurely Attached Individuals Gender differences in oxytocin' s effects on interpersonal adaptability in insecurely attached individuals also require further investigation. Although much oxytocin research has used male participants, studies show that oxytocin produces different effects in men and women. Altemus et al. (1999) found gender differences in endogenous oxytocin levels, with women having higher oxytocin concentrations in cerebrospinal fluid. Domes et al. (2010) found that oxytocin may enhance amygdala activity in women but reduce it in men, suggesting that oxytocin enhances amygdala activity in women to maintain high vigilance toward threatening emotional stimuli for defensive behavior, while reducing amygdala activity in men decreases attention to threatening cues, thereby facilitating social interaction and improving men' s interpersonal adaptability. Chen and Johnson (2012) found that women with at least one A allele at OXTR rs2254298 reported higher attachment anxiety scores than women with two G alleles, but this result was not found in men, further demonstrating gender differences in how oxytocin affects interpersonal adaptability in insecurely attached individuals. Riem, Bakermans-Kranenburg, and Van Ijzendoorn (2016) examined 42 childless women after exogenous oxytocin administration, measuring their stimulus perception and handgrip force when hearing infant crying. They found that exogenous oxytocin reduced excessive handgrip force and amygdala responses in insecurely attached women when hearing infant cries. Due to women' s menstrual cycles and estrogen effects, future research could examine inherent gender differences in oxytocin levels before experiments, manipulate oxytocin dosage during experiments to investigate specific relationships with social behavior, and further explain the causes of gender differences (Yue Tong, Huang Xiting, & Liu Guangyuan, 2017; Yue Tong, Huang Xiting, & Liu Guangyuan, 2018). Comparing gender differences in oxytocin' s effects on interpersonal adaptability in insecurely attached individuals will provide further information for maintaining

interpersonal relationships. Although oxytocin is associated with many positive social behaviors, it is also related to pain and negative emotions in interpersonal relationships, with gender playing an important role.

5.3 Investigating Oxytocin' s Effects on Interpersonal Adaptability in Insecurely Attached Individuals During Interpersonal Interaction
Finally, investigating oxytocin' s effects on interpersonal adaptability in insecurely attached individuals during actual interpersonal interaction represents an important future research direction. This article examined oxytocin' s effects on interpersonal adaptability in insecurely attached individuals from the perspective of different oxytocin sources. However, we find that most oxytocin research has been conducted in laboratories, while interpersonal adaptability primarily emphasizes interpersonal interaction processes. Consequently, the ecological validity of findings on oxytocin' s effects on interpersonal adaptability in insecurely attached individuals is relatively low. Research shows that oxytocin response patterns differ across environmental stimuli (Lucht et al., 2009). For example, Julian et al. (2017) studied the relationship between salivary oxytocin levels and parenting behavior in mothers with different early life stress levels, finding that mothers with low early life stress and high oxytocin levels showed more positive parenting behavior, while mothers with high early life stress and high oxytocin levels showed more negative parenting behavior. Since environmental factors importantly moderate oxytocin' s social effects, future research should not be limited to laboratory studies of oxytocin' s effects on interpersonal adaptability in insecurely attached individuals but should focus on interpersonal interaction processes and consider environmental factors to enhance the ecological validity of oxytocin research.

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