

Taking the focus away from the self:

Low individualism mediates the effect of oxytocin on creativity

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Abstract

Recently, it has been shown that the hormone oxytocin can enable creative cognition. The aim of the current investigation was to examine the psychological mechanism via which oxytocin influences creativity. Two opposing explanatory approaches suggested by previous research were investigated: It was predicted that the effect of oxytocin on creativity would be determined by low versus high individualism, especially in people with low levels of anxiety. Participants filled out an anxiety questionnaire and intranasally administered oxytocin or a placebo. After a 40-min waiting period, they performed a creativity task and indicated their level of individualism. Participants with low levels of anxiety showed heightened creative potential under oxytocin and this relationship was mediated by low individualism. The results could not be explained by changes in the participants' affective state. The findings underscore the moderating role of dispositional factors and reveal an important factor to understand the role of oxytocin in human behavior. (151 words)

Keywords: oxytocin; creativity; individualism; anxiety

Taking the focus away from the self:**Low individualism mediates the effect of oxytocin on creativity**

Creative insights and solutions have always been a driver of human development and are still highly valued in contemporary society as they facilitate progress in sciences, humanities, and arts (e.g., Mithen, 1998). Creativity is defined as the ability to develop novel products, ideas, or problem solutions that are of value to an individual or a larger social group (see Hennessey & Amabile, 2010). Divergent thinking plays a central role in creative thought (Guilford, 1967) and divergent thinking indexes are commonly used as a popular measure of creative processing abilities (see Hennessey, & Amabile, 2010). In recent years, researchers have begun examining how the brain generates creative ideas. Initial evidence for the idea of a biological basis of creativity revealed a relationship between semantic activations of the right hemisphere and creative solutions (Bowden & Jung-Beeman, 1998; Bowden & Jung-Beemann, 2003; Jung-Beeman & Bowden, 2000). Taking the endocrine system in account, researchers also found a negative relationship between dopamine and creativity (Lhommée et al., 2014). Recently, it has been revealed that the hormone and neurotransmitter oxytocin also has a facilitative effect on creative cognition: Administration of intranasal oxytocin lead to enhanced holistic processing, divergent thinking and creative performance (De Dreu et al., 2014). However, the exact mechanism through which oxytocin influences creativity remains unclear.

A set of individual personality factors makes some individuals more creative than others including independence of judgment and autonomy (Barron & Harrington, 1981). This is a result of creative ideas often being deviant (Moscovici, 1976) and most people hesitating to express them in a group that could evaluate them negatively (Diehl & Stroebe, 1987). Therefore, traits like independence or autonomy allow individuals to more readily break with their social groups and offer novel ideas. In contrast, De Dreu et al. (2014) proposed that oxytocin exerts its effect on creativity by enhancing social approach behavior. Approach-

based motivational states have been shown to be beneficial for creative performance (De Dreu, Nijstad, & Baas, 2011; Friedman & Förster, 2000) because they signal a benign and tolerant environment in which one can freely explore alternatives in an unconstrained manner (Friedman & Förster, 2010; Schwarz & Bless, 1991).

The current study was designed to replicate the effect of oxytocin on creativity and, importantly, to test the opposing explanations for this effect. Crucially, it was examined whether the effect of oxytocin on creativity is related to high individualism (a tendency to look after oneself; Hegar, 2012), as suggested by the independence / autonomy assumption and found in previous research (Goncalo & Staw, 2006), versus low individualism (a tendency to emphasize affiliation; Hegar, 2012), as theoretically suggested by De Dreu et al.'s (2014) approach hypothesis. There is also some empirical evidence that oxytocin weakens self-related processing (Liu, Sheng, Woodcock, & Han, 2013), pointing to a decrease of individualism under oxytocin.

Other work has shown oxytocin to be a powerful promoter of social cognition and prosociality in humans: Inter alia, oxytocin improves social memory (Guastella, Mitchell, & Mathews, 2008) and mind-reading skills (Domes, Heinrichs, Michel, Berger, & Herpertz, 2007), and promotes behaviors like cooperation (Declerck, Boon, & Kiyonari, 2010) and conformity (Stallen, De Dreu, Shalvi, Smidts, & Sanfey, 2012). However, these effects have been revealed to be highly personality and context dependent (Bartz, Zaki, Bolger, & Ochsner, 2011). In particular, low levels of trait anxiety have increasingly been shown to promote approach behaviors under oxytocin (Bartz et al., 2010; Radke, Roelofs, & de Bruijn, 2013). This personality trait might serve as a favorable filter through which relationships are construed (Bartz et al., 2010). Therefore, trait anxiety was included as a possible moderator of the effect of oxytocin on creativity.

Overall, it was hypothesized that people with low levels of anxiety would show increased creativity under oxytocin versus a placebo and that this relationship would be

mediated by low versus high individualism. To test this prediction, participants intranasally administered either oxytocin or a placebo. To examine creative output, participants' performance on a drawing task requiring creative potential (e.g., Gutbezahl, & Averill, 1996) was investigated. To capture the concept of individualism in the context of creativity, items were selected from of a scale measuring individualism (Singelis, Triandis, Bhawuk, & Gelfand, 1995) that were most closely related to the idea of psychological and behavioral divergence.

Method

Participants

Sixty-one male students (mean age = 27.57 years, $SD = 10.07$) from a German university participated in this study that ostensibly investigated psychobiological determinants of self-concepts. Participants were not allowed to participate if they reported significant medical or psychiatric illness, medication, smoking more than five cigarettes per day, drug or alcohol abuse, allergies, and hypersensitivity to preservatives in the oxytocin spray. Three participants who did not perform the creativity task accurately were excluded, resulting in the above sample. Participants were instructed to abstain from smoking or drinking (except water) for 2 hours before arrival. Written informed consent was obtained. The study was approved by the University of Munich Ethics Committee.

Design and procedure

The study was conducted following a randomized, placebo-controlled, double-blind, between-subjects design.

Participants initially filled out the trait anxiety questionnaire. Then, they self-administered either 24 I.U. (three puffs per nostril) of oxytocin (Syntocinon Spray, Defiante) or a placebo (sodium chloride solution) under experimenter supervision. A 40-min waiting period followed which allows oxytocin to be effective. Participants subsequently performed

the creativity and another unrelated task and completed a questionnaire containing items on individualism and mood. Finally, they were debriefed and paid (€5).

Materials

Trait anxiety. Participants completed the widely used 20-item Trait Anxiety Inventory (Laux, Glanzmann, Schaffner, & Spielberger, 1981, 1981; $\alpha = .89$) which measures anxiety as personality trait (e.g., “I become nervous and restless when I think of my current issues”). All questions were answered on a 1 = not at all to 4 = very much response scale.

Creativity task. The task was adapted from procedures by Masuda, Gonzalez, Kwan, and Nisbett (2008). Participants were asked to draw a landscape picture within 5-min. In this picture, they were instructed to include at least a house, a tree, a river, a person, and a horizon, and they were told to feel free to draw additional objects. After data collection, two judges who were blind to hypotheses and conditions viewed all drawings and evaluated them according to their creative potential as follows: For each drawing, they assessed how original (interrater reliability: intraclass correlation coefficient = .70), fresh (ICC = .74), and divergent (ICC = .61) they considered it on a 1 = not at all to 7 = very much scale. After calculating the average rating score for each of the three items, an overall creative potential score was created by taking the mean of the three items ($\alpha = .95$). To differentiate between quality and mere quantity, the raters moreover counted the additional objects that the participants were allowed to include (ICC = .87); likewise, an average rating score was calculated.

Individualism. Participants completed the following four items of Singelis' et al. (1995) individualism scale on a 1 = not at all to 7 = very much response scale ($\alpha = .65$): “My independence from others is very important to me”, “I'd rather depend on myself than on others”, “I enjoy working in situations involving competition with others”, “Some people emphasize winning; I'm not one of them (recoded)”

Mood. Participants completed four positive (e.g., “happy”; $\alpha = .85$) and four negative affect items (e.g., “sad”; $\alpha = .73$) of Brunstein's (1993) affect scale on a 1 = not at all to 7 =

very much response scale. This was assessed to be able to differentiate between individualism and the more unspecific concept of mood.

Results

Main analyses. To test whether creative potential in response to oxytocin administration was moderated by anxiety, and this relationship was mediated by individualism, a moderated mediation analysis was conducted using the PROCESS tool by Hayes (2013). The direct effect revealed to be moderated, as indicated by a significant interaction between substance and trait anxiety in the model of creativity, holding level of individualism constant, $b = 0.45$, $SE = .15$, $t(57) = 3.07$, $p = .003$, 95% CI = [0.16, 0.75], variation explained by model: $R^2 = .17$. Only participants with low levels of anxiety showed significantly more creative potential under oxytocin than under placebo, $b = -0.65$, $SE = .21$, $t(57) = -3.12$, $p = .003$, 95% CI = [-1.07, -0.23]. Participants with high levels of trait anxiety did not differ in their creative potential, $b = 0.26$, $SE = .20$, $t(57) = 1.27$, $p = .210$, 95% CI = [-0.15, 0.66], see Figure 1. There was neither a main effect of substance nor a main effect of anxiety, $ps > .174$.

Further, the model of individualism revealed a significant interaction between substance and anxiety, $b = -0.28$, $SE = .13$, $t(57) = -2.18$, $p = .034$, 95% CI = [-0.54, -0.02], variation explained by model: $R^2 = .12$. Individualism mediated the effect of substance on creative potential among participants with low levels of trait anxiety, $b = 0.10$, $SE = .08$, 95% CI = [0.01, 0.33], but not among participants with high levels of trait anxiety, $b = -0.01$, $SE = .05$, 95% CI = [-0.15, 0.05]. That is, participants under oxytocin had lower levels of individualism than participants under placebo among those with low but not high levels of anxiety, and this in turn translated into more creative potential, see Figure 2. Again, there were no significant main effects, $ps > .103$.

Additional analyses. The moderation analysis with additional objects instead of creative potential as dependent variable revealed no significant effects, $ps > .217$. Moreover,

neither positive, $p = .381$, nor negative mood, $p = .926$, instead of individualism mediated the relationship between oxytocin and creative potential.

Discussion

People with low levels of anxiety showed heightened creative potential under oxytocin and this relationship was mediated by low individualism. This pattern only emerged for creativity as judged by the rated quality of creative potential in a landscape drawing task but not for the quantitative extent of creative effort as indexed by the number of objects depicted in the scene. Further, individualism could not be replaced by positive or negative mood as a mediator indicating that the participants' affective state could not provide an explanation of the findings.

In our study, oxytocin increased creative potential selectively for people with low trait anxiety. A main effect of oxytocin on creative potential as previously reported by De Dreu et al. (2014) was not observed. However, these authors acknowledged that some of the effects they observed appeared to be relatively weak. In a recent literature review, weak effect sizes in oxytocin studies were linked to the assumption that the effect of the hormone are constrained by features of individuals or situations (Bartz, et al., 2011). Indeed, our results supported previous research finding low levels of trait anxiety to moderate the impact of oxytocin (Bartz et al., 2010; Radke et al., 2013).

Importantly, our findings also revealed that low (and not high) individualism mediated the relationship between oxytocin and creative potential. Low individualism is associated with belonging and affiliation (Hegar, 2012) why the current study empirically supports De Dreu et al.'s (2014) suggestion that an approach orientation is responsible for the found pattern. This is consistent with findings showing that approach-based motivational states, like engaging in approach-relevant motor actions (Cretenet & Dru, 2009; Friedman & Förster, 2000) or possessing approach-oriented traits (De Dreu et al., 2011; Furnham & Bachtiar, 2008), facilitate creative output as they signal a benign environment in which one can

unconstrainedly explore alternatives (Friedman & Förster, 2010; Schwarz & Bless, 1991). Creative potential caused by oxytocin, thus, is not based on independence and autonomy (Barron & Harrington, 1981) and does not “occur in isolation” (Shalley & Gilson, 2004, p. 42) but instead in a state of decreased self-centeredness.

It has been suggested that the apparently complex social effects of oxytocin might be mediated via relatively simple mechanisms like a generalized anti-anxiety (anxiolytic; Churchland & Winkielman, 2012) or social saliency effect (Bartz et al., 2011). The observed effect of oxytocin on individualism might serve as an alternative parsimonious explanatory mechanism of oxytocin’s impact on social cognition and prosocial behaviors: Decreased individualism caused by intranasal administration of oxytocin could account for effects like facilitated mind-reading (Domes et al., 2007) or increased conformity (Stallen et al., 2012)—situations in which a focus outside the self is favorable.

In combining a behavioral creativity measure with a hormonal manipulation, the current study was able to replicate and extend previous findings. Nevertheless, some limitations of our study should be addressed: De Dreu et al.’ (2014) approach hypothesis might not only be applied to a decrease of individualism but also to an increase in collectivism. This possibility cannot be excluded because an adapted measure of individualism and not a direct measure of collectivism was used, as previous research has indicated that oxytocin lowers self-referential processing (Liu et al., 2013). However, individualism and collectivism seem to represent opposite ends of a single dimension (Triandis, 1989) why similar results for the concept of collectivism can be expected. Methodologically, it should moreover be noted that our measures of individualism and creativity only had modest (interrater) reliabilities and that only male participants were tested, as is the case in most studies of oxytocin. A replication including different measures and a more heterogeneous sample would move us towards a better understanding of the found pattern. Another potential criticism of the study is the way in which creative potential was measured: As in previous research (e.g., Gutbezahl, & Averill,

1996), participants' creative performance was investigated using a drawing task and rating the extent of creative potential in the participants' drawings. Although this qualitative approach allows for a more dynamic and open output, more robust effects could be induced from quantitative procedures like the Alternate Uses Test (Christensen, Guilford, Merrifield, & Wilson, 1960; for an overview, see Long, 2014).

Very few previous studies have directly investigated the mechanism by which oxytocin influences behavior. As previously observed (Cardoso, Ellenbogen, & Linnen, 2012), the current study found intranasal oxytocin to alter specific self-perceptions, in this case the level of individualism that promoted creative potential specifically in those with low levels of anxiety. In finding that low individualism or even collectivism—concepts that are closely attached to the social context (Singelis et al., 1995)—is a crucial factor, our results might give an important clue to understand the role of oxytocin in human behavior. In the future, this could prove useful in guiding attempts to apply the hormone as a treatment in pathological conditions such as autism or schizophrenia.

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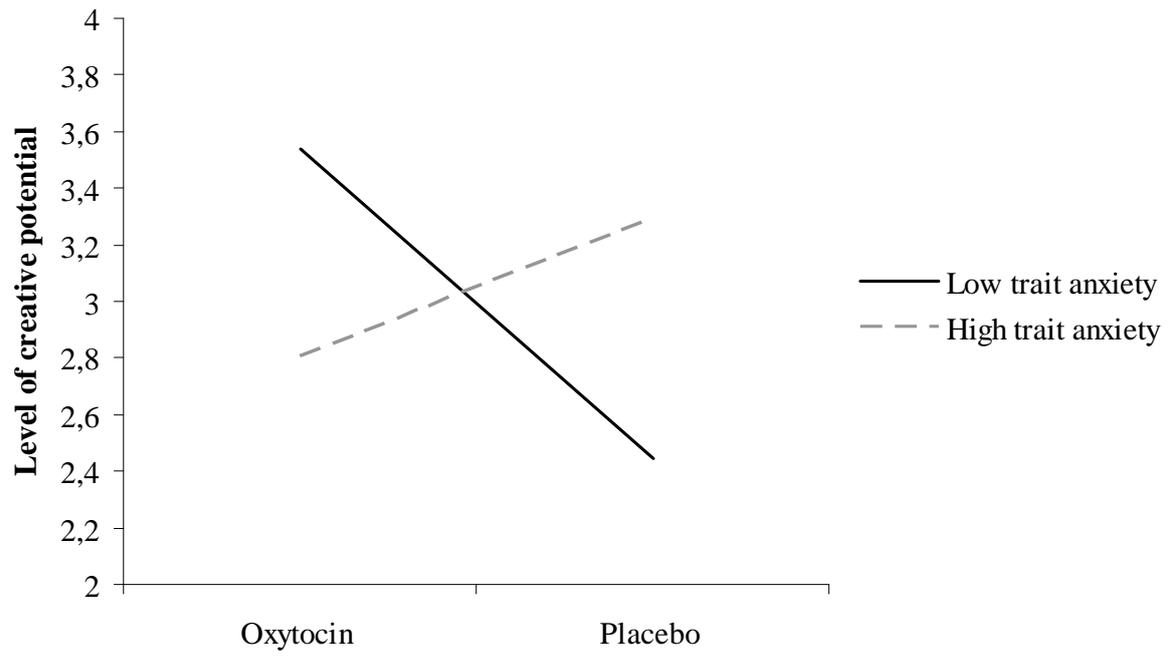


Figure 1. Level of creative potential under oxytocin vs. placebo predicted by trait anxiety.

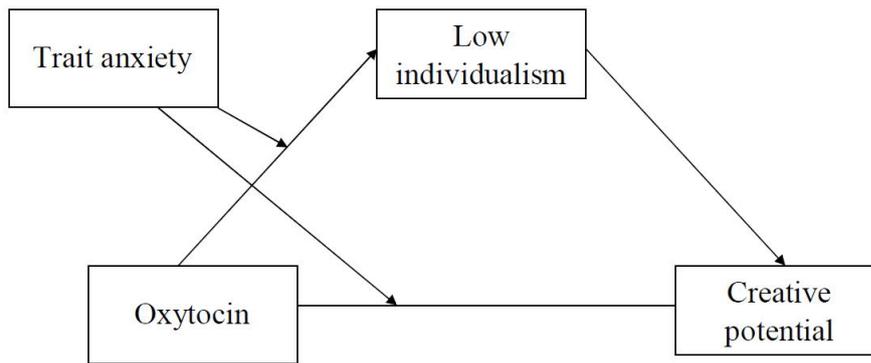


Figure 2. Moderated mediation: Participants under oxytocin had lower levels of individualism than participants under placebo among those with low but not high trait anxiety, and this in turn translated into more creative potential.

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