

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

Anna Soler Campillo

S1477528

Applied Neuroscience in Educational and Child Studies

Dr. Renske Huffmeijer

ABSTRACT

Evidence suggests the existence of a possible correlation between oxytocin levels, degree of empathy and in turn prosocial behavior. To further our understanding, the current study examined the hypothesis whether donating behaviour could be explained by an influence of endogenous oxytocin on empathic concern. Thirty undergraduate 18-30 year old female students were selected from a larger study (van IJzendoorn, Huffmeijer, Alink, Brakermans-Kranenburg & Tops, 2011), which consisted of two experimental sessions. The current study conducted a secondary analysis of some of the data gathered during the second session of the original study, specifically from the participants who received a saline solution in the second experimental session. Levels of endogenous oxytocin in saliva samples, measures of empathy (interpersonal reactivity index questionnaire) and donations to measure donating behavior; were gathered in the original study and were also analyzed in the current study. Several simple regression analyses as well as a multiple regression analysis were conducted to test the hypothesis. The findings revealed no significant explanatory power of endogenous oxytocin and empathic concern on donating behaviour. Thus, the hypothesis was not confirmed. Both the use of an out-group individual as a recipient of the donations and the fact that all participants were likely highly socially proficient and empathic, may explain the null results. For future research it is recommended to use a more diverse sample including participants with both high and low social skills and to compare donating behaviour to in-group and out-group recipients. Finally, the differences between the prosocial effects of endogenous versus exogenous oxytocin levels should be determined.

INTRODUCTION

As humans we are prosocial by nature since we have always been prone to engage in costly acts to aid others (Kurzban, Burton-Chellew & West, 2015). Charitable giving is a common form of prosocial behaviour, since donations are a key way to support the development and relief of areas in need for charity (Atkinson, Backus, Micklewright, Pharoah & Schnepf, 2011). In addition, there is evidence about people being happier when investing money to enhance others' life (Dunn, Aknin & Norton, 2014). This is the reason why it would be relevant to study further about charitable giving and ways of promoting it. Specifically, there is some evidence that suggests that oxytocin (OT) and empathy have prosocial effects on charitable giving. Therefore, the aim of the current study is to determine whether there is a positive correlation between endogenous levels of OT and donating behaviour. And a second aim is to determine if empathic concern plays a mediating role in this correlation. In brief, this study attempts to further our understanding about the prosocial effects of endogenous OT on donating behaviour and the role that empathy may play in this relationship.

Oxytocin (OT) is a nonapeptide mammalian hormone, which is secreted in magnocellular neurons of the paraventricular (PVN) and supraoptic (SON) nuclei of the hypothalamus. It is transported to the posterior lobe of the pituitary gland at the base of the brain, where it is then released into the blood (Campbell, 2008). OT has peripheral and central effects. Centrally, OT acts as a neuromodulator which influences the neurocorrelates of intimacy, specifically in sexual reproduction, during and after childbirth. Central OT release and neuronal activity can be elicited by both sexual and reproductive stimuli and non-sexual stimuli. Central OT also promotes maternal behaviour, pair bonding, offspring preference, social contact and social recognition. Peripherally, OT facilitates milk ejection, uterine contractions, parturition, copulation and ejaculation (Campbell, 2008).

OT and prosocial behaviour

OT is known to promote prosocial behaviour which consists of engaging in actions aimed to benefit others than oneself, including comforting, sharing, being generous and cooperating (Campbell, 2008). Prosocial behaviour is promoted by altruism which is the intention to enhance others' welfare without getting any benefits from the altruistic action, which may in turn cause some personal costs to the altruist (Robert & Trivers, 1971). It is important to note that prosocial behaviour includes generosity and cooperation.

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

This is the reason that many studies talk about generosity and cooperation when discussing about prosocial behaviour (e.g. Campbell, 2010).

There is evidence that intranasally administered (exogenous) OT increases trust which in turn promotes generosity in a trust/betrayal game (Kosfeld et al, 2005). In a trust/betrayal or ultimatum game, the investor receives a certain amount of money and decides how to divide the money with the other player, the recipient, who can refuse or accept the offer. If the money is accepted, the recipient decides whether to return some money to the investor and how much. Kosfeld et al (2005) observed in their study that exogenous OT enhanced trust and in turn, incited a fair division of the money. Yet that only occurred when at least one of the individuals feared to be betrayed by the other and when both participants of the interaction were humans (social condition), but not when a pre-programmed computer was one of the game partners. These results suggest that an increase in trust may be a consequence of a decrease in fear of social betrayal, which in turn may lead to an increase in OT levels and promote prosocial behaviour. Altogether, greater exogenous OT levels appear to enhance trust behaviour, when facing social betrayal, which in turn leads to generosity (Kosfeld et al, 2005).

There is more support for the function of OT in promoting trust through the reduction of fear of social betrayal (Baumgartner et al, 2008). It appears that, while playing in a trust/betrayal game, knowing that one's current partner betrayed in previous games (negative feedback of betrayal) increases the impact of OT on promoting trust and prosocial behaviour (Baumgartner et al, 2008).

In sum, it seems that OT may promote prosocial behaviour through the enhancement of trust but only under a social condition, when the recipient is a person, and when facing risk of social betrayal.

OT and empathy

OT has also been found to be related to empathy (MD. Macdonald & RN. Macdonald, 2010), which is the ability to spontaneously adopt the perspective of another person and be able to see things from another's point of view (Davis, 1980). Empathizing involves differentiating between oneself and another. Therefore, the empathizer is aware that another's experience is not one's own experience (Eisenberg, Shea, Carlo & Knight, 2014).

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

There are two different kinds of empathy; one is affective empathy which is the elicitation of an affective state caused by the perception, inference or imagination of the other's affective state; which may be similar and oriented towards the other's affective state. The other one is cognitive empathy which is the comprehension of others' feelings without inferring the other's affective state (Walter, 2012).

Evidence suggests that exogenous OT may enhance the inferring of the others' mental state when the eye region is used as a social cue (Domes, Heinrichs, Michel, Berger, & Herpertz, 2007). This suggestion comes from a study that examined participants' skills in inferring others' mental states through the Reading the Mind in the Eyes Test. Performance was compared between the participants that received an intranasal administration of OT versus the ones who received placebo. Performance was greater in the OT group relative to the placebo group (Domes et al, 2007).

In the same vein, it appears that exogenous OT may enhance empathy when receiving positive and negative social feedback relative to non-social feedback (Hurlemann et al, 2010). This phenomenon was observed in a study from Hurlemann et al (2010), who also found out that the raise in empathy in men, after OT treatment, was similar to endogenous levels in women. These researchers suggested that this may imply that women also show greater release of OT relative to that in men (Hurlemann et al, 2010).

Very recent evidence suggests that OT's effects on empathy may be greater when imaging others in pain relative to imaging oneself being in pain (Abu-Akel, Palgi, Klein, Decety, & Shamay-Tsoory, 2015). This evidence comes from a study that compared the impact of OT on the empathic responses of the participants, who either received OT or placebo, while imaging oneself (self-perspective empathy) relative to the other (other perspective empathy) being in pain or not. The OT condition showed greater empathy when imaging others in pain versus imaging oneself in a painful situation. In contrast, the placebo group showed no differences in empathy when perceiving one self's pain or other's pain. From these findings, the researchers suggested that empathy towards others may occur when distinguishing between self and other's emotional mental states (Abu-Akel et al, 2015).

To conclude, it appears that OT may increase empathy, especially when using the eye region as a social clue, when receiving social feedback, and when being aware of the difference between self and other's emotional mental states.

Empathy, prosocial behaviour and charitable giving

It appears that empathy may promote prosocial behaviour and in turn, donations to charity. Sze, Gyurak, Goodkind & Levenson (2011) observed increases in empathic concern and prosocial behaviour in the participants after watching two empathy films that showed people in need for charity; one film was uplifting and the other distressing. Empathy was assessed through the measure of cardiac physiological responses while watching the films and through the participants' rate of empathic concern levels after each film. Prosocial behaviour was measured according to the participants' decisions to donate to the charities promoted in the films. The findings also revealed that the participants reported higher distress to the distressing film. In addition, empathic concern, cardiac reactivity and personal distress were related to a raise in donations to charity. So, this study not only suggests that empathy may promote prosocial behaviour, but that empathy may also be related to charitable giving (Sze et al, 2011).

Interestingly, there is also evidence about the existence of three forms of dispositional empathy that may influence donating behaviour: empathic concern, perspective taking, and personal distress (Kim & Kou, 2014). It seems that empathic concern increases the decision and the amount donated, which corresponds to the findings found by Sze et al (2011). In contrast, perspective taking has been found to reduce the probability of donating but to enhance the amount donated. Finally, it has been observed that personal distress promotes the decision to donate but has a negative correlation with the amount of donations (Kim & Kou, 2014). Altogether these findings suggest that empathy may promote prosocial behaviour, including donations to charity.

OT, empathy and charity

To this point, evidence has been shown about possible relationships between OT and empathy, OT and prosocial behaviour, and empathy and prosocial behaviour. But there is still more; the likely existence of a correlation between OT, empathy and prosocial behaviour has also been determined.

It has been suggested that empathy may be involved in the impact of exogenous OT on prosocial behaviour (Zak et al, 2007). In the study from Zak et al (2007), a greater effect of exogenous OT on generosity was observed in the participants while playing in an ultimatum game, since the donors donated more money.

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

The findings revealed that exogenous OT increased generosity in an ultimatum game. This phenomenon is probably due to the fact that this game involves perspective-taking; since the donor has to decide what offer is more likely to be accepted by the other player. Therefore, this perspective-taking may incite the donor to be concerned about the possibility of the recipient having a negative emotional response due to an unfair offer. In addition, exogenous OT increased this concern since it seemed that OT enhanced the awareness of the others' experience when facing a negative emotion. In turn, this concern persuaded the will to ameliorate the others' experience of negative emotions. Therefore, the investor's concern in preventing the expected distress from the recipient enhanced generosity. This concern could be considered as empathy as it involves perspective-taking. These results suggest that the effect of OT may work through empathy-mediated generosity rather than generous behaviour per se (Zak et al, 2007).

In the same vein, there is stronger evidence about the influence of empathy on the impact of OT on prosocial behaviour. It has been observed that an emotional video may be efficient at triggering a raise in endogenous OT levels as well as at increasing empathy levels; which in turn promotes higher donations to charity (Barraza & Zak, 2009). Thus, it has been suggested the existence of a positive relationship between empathy, raised endogenous OT levels and enhanced charity giving. Interestingly, it has been found a stronger correlation between OT levels and empathy among women relative to that in men (Barraza & Zak, 2009). It is important to emphasize that this is the first evidence to determine a possible role of endogenous OT on prosocial behaviour.

In a later study the same authors (Barraza et al, 2011) further examined the OT's effects on donating behaviour. These researchers claimed that OT may also increase indirect generosity that has delayed and distant benefits. It seems that the prosocial effects of greater exogenous OT levels may generalise from individuals to a group who is in need of charity help, since it has been observed that exogenous OT promotes donations to charity organizations. It has been suggested that individuals might be more prone and motivated to donate money to charity because of the perceived need of the charity recipients. Therefore, the perception of people in need may trigger an empathic response in helping to ameliorate the others' suffering. Thus, once again it has been determined the existence of a possible role of empathy in the relationship between OT and prosocial behaviour. (Barraza et al, 2011).

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

Finally, a very recent study provides the first evidence suggesting that OT has an indirect correlation with prosocial behaviour, which may be mediated by empathic concern and perspective-taking (Christ, Carlo & Stoltenberg, 2015). Thus, empathic concern and perspective-taking may have a direct impact on prosocial behaviour. Specifically, empathy may promote a selfless form of pro-sociality (Christ, Carlo & Stoltenberg, 2015).

In brief, it seems that empathy may be related to OT and prosocial behaviour, suggesting that empathy may play a mediating role in a possible indirect relationship between OT and prosocial behaviour. Therefore, OT may affect prosocial behaviour through the influence of empathy.

Research questions and hypothesis

In sum, there is strong evidence suggesting the existence of a positive association between OT, empathy and prosocial behaviour (eg. Barraza & Zak, 2009). Nevertheless, most research has used economic games to test the influence of OT on prosocial behaviour (e.g. Zak et al, 2007). Besides, there is growing evidence for exogenous OT affecting prosocial behaviour (e.g. Kosfeld et al, 2005), whereas less is known about how endogenous OT influences generosity (e.g Barraza & Zak, 2009). Additionally, despite the evidence that women present higher rates of empathy and generosity (e.g. Hurlemann et al, 2010), most studies have been conducted in males (e.g. Baumgartner et al, 2010). Lastly, the few studies conducted in females did not control for possible confounding effects of menstruation cycle and use of oral contraceptives (e.g. Barraza & Zak, 2009).

For the reasons presented above, it is relevant to conduct a study which further analyses the effects of endogenous OT on empathy and donating behaviour in females. We investigate whether OT affects donations to charity through the mediating role of empathy. Finally, the researchers will examine possible confounding effects of menstruation cycle and use of oral contraceptives.

Altogether, our research aims to test a mediation model in which empathy plays a mediating role in the relationship between OT and donating behaviour. Thus, we will test whether donating behaviour can be explained by the influence of OT on empathic concern. Our main hypothesis predicts that endogenous OT will enhance empathy which in turn may result in greater donations to charity.

METHOD

Participants

The sample in this research (N=30) was a subsample of participants from a larger study (N=57), (van IJzendoorn, Huffmeijer, Alink, Brakermans-Kranenburg & Tops, 2011). For the original sample undergraduate 18-30 years old (M=20.23, SD=2.66) female students from Leiden University were randomly recruited.

Exclusion criteria were colorblindness, smoking, abusing alcohol or drugs, neurological or psychiatric disorders, being pregnant, breastfeeding and using medication (except oral contraceptives). The study received the approval of the ethic committee of the Leiden University Medical Center, and each participant provided informed consent.

Procedure

The participants attended two experimental sessions separated by four weeks, which took place between 12 am and 3 pm to ameliorate the influence of diurnal variations in OT levels. Before starting with the first session, participants were asked about the last day of their menstruation and if they were using any kind of oral contraceptive. The participants were also instructed to fill in other questionnaires (see Huffmeijer et al (2011) for more details on these questionnaires).

At the start of each session, a sample of saliva was taken from the subjects to analyze endogenous OT levels. Following this, the researchers conducted a double blind administration of oxytocin (OT) to half of the participants and a saline solution (placebo) to the other half, through a nasal spray. All participants received both substances, but they did not know in which session they received each substance. Afterwards, responders engaged in a flanker task in which brain activity was measured using an electroencephalogram (EEG) during the task (EEG; see Huffmeijer et al (2011) for details on this task). Then participants were also instructed to fill in the Interpersonal Reactivity Index (IRI) questionnaire among other questionnaires (see Huffmeijer et al (2011) for details on these questionnaires) and another sample of saliva was taken to analyze both exogenous (intranasally administered) and endogenous OT levels.

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

After the completion of the EEG task and the questionnaires of the second session, participants received 50 euros for participating in the study. Next, they were asked to watch a video from UNICEF for a donating task.

In brief, both sessions followed the same experimental procedure, with the only difference that at the end of the second session participants received the money for participating and also engaged in a donating task. For this study, we reported some of the data from the original study that was collected during the second session: levels of endogenous OT in salivary samples, and measures of empathy (IRI questionnaire) and data for the donating task to measure donating behavior (all collected during the second session). Importantly, we only analyzed these data from the group who received a saline solution (placebo) in the second session, since the aim of this study was to examine the prosocial effects of endogenous OT levels.

The participants were instructed to abstain from alcohol and excessive physical activity in the twenty-four hours preceding each session, and to abstain from caffeine on the day the sessions took place.

Measures

Our study focused on examining whether endogenous OT levels are related to an increase in empathic concern, which may in turn promote donations to charity. To test these effects, we analyzed some of the data collected in the original study (van IJzendoorn et al, 2011), listed below:

Control variables: Menstruation cycle and use of oral contraceptives

The participants were asked for the last day of their period to know in which phase of the menstruation cycle they were during the study. They were also asked whether they were using any kind of oral contraceptive.

Salivary oxytocin

The researchers collected saliva samples from the participants to measure endogenous OT levels. As previously mentioned, we only examined the data of the saliva samples from the group who received a saline solution (placebo) in the second session.

Interpersonal Reactivity Index (IRI)

The Interpersonal Reactivity Index (IRI) was used to measure empathy. The IRI is a self-report questionnaire that consists of 28 items, divided into four 7-item scales of affective and cognitive empathy: Perspective Taking, Fantasy, Empathic Concern and Personal Distress. Each item was scored with a scale from 1 to 4. For our study we analyzed only the empathic concern data since it seems that empathic concern increases the decision and the amount donated (Sze et al, 2011).

Donating to UNICEF

A donating task was conducted to measure donating behavior. Once the participants had received money for having participated in the study, the subjects were instructed to watch a short 2 minute UNICEF promotional video. This video portrayed a child from Bangladesh who could not go to school because of having to do forced work in a stone pit, and at the end, the video asked to donate money. The participants did not know this task was part of the experiment. Next to the responders there was a covered money box with some coins in to assure the credibility of the task. Donating behavior was measured by the amount of money the participant donated in response to the videotape. As all money boxes contained 5 euros, the researchers could see how much money had been deposited.

Statistical analyses

We hypothesized a mediation model in which endogenous OT promotes donating behavior through the enhancement of empathic concern (See figure 1). We performed statistical analyses with the SPSS statistics 20 software package to test this hypothesis.

The variable menstruation cycle (MC) was recoded from four categories to two categories depending on the menstruation cycle phase participants were during the experimental sessions: (MC_recoded) Follicular phase= 1 (1st or 2nd week), Luteal Phase=2 (3rd or 4th week).

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

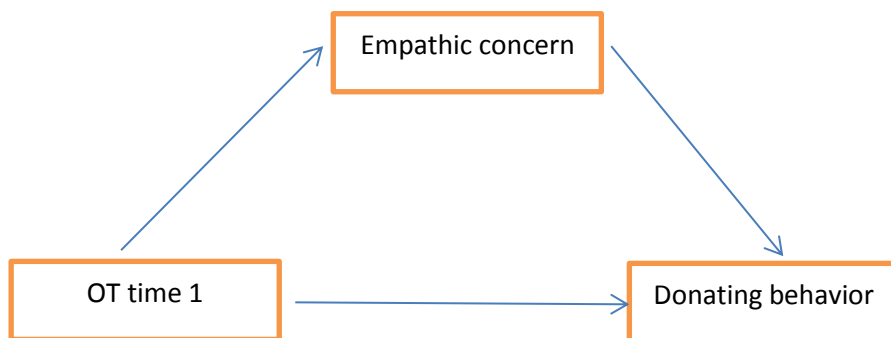


Figure1. Illustration of the mediation model between oxytocin, empathic concern and donating behavior.

Univariate data Inspection

We conducted a descriptive analysis of the numerical variables (donations, empathic concern, OT time 1) to analyze the normality of their distributions by the examination of histograms, skewness, kurtosis and outliers.

Analysis methods

Several regression analyses were conducted to test the hypothesis which states that the levels of endogenous OT time 1 (predictor) has a linear, positive relationship with donations to charity (outcome), and empathic concern (mediator) plays a modulation role in the relationship between OT time 1 and donations to charity. Altogether, we tested a mediation model in which donations to charity may be explained by the influence of OT levels on empathic concern.

We examined four hypotheses, necessary to confirm this model. The first assumption states that the level of OT time 1(predictor) is significantly related to empathic concern (outcome) and it was tested with a simple regression analysis. The second assumption states that the level of OT time 1(predictor) is significantly related to donations (outcome) and it was tested through a simple regression analysis. The third one predicts that empathic concern (predictor) is significantly related to donations (outcome) and it was tested through a multiple regression analysis.

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

The fourth hypothesis proposes that when controlling for the effects of empathic concern (mediating variable) on donations (outcome), the effect of the level of OT time 1 (predictor) on donations (outcome) would no longer be significant. The last hypothesis was tested with a multiple regression analysis.

We also ran two independent sample T-tests to examine possible confounding effects of the variables menstruation cycle and use of oral contraceptives, on endogenous OT time 1 levels. The first t-test examined whether there were significant mean differences in OT time 1 between the participants who were taking the contraceptive pill while engaging in the study versus those who were not. Another independent sample T-test was conducted to check whether there were significant mean differences in endogenous OT time 1 between the participants who were in the follicular menstruation phase versus the ones who were in the luteal menstruation phase.

RESULTS

Univariate Analysis

Descriptive statistics: analysis of distributions

The variable donations reveals that most of the sample gave a mean of 2.68 euros ($SD=2.51$). The mean score of OT time 1 is 6.57 ($SD=4$). The participants scored high in empathic concern ($M=2.95$, $SD=0.4$) in a scale of 0-4.

The descriptive results show an acceptable skewness and kurtosis in donations ($Zskewness=2.34$, $Zkurtosis=1.20$), a near symmetric skewness and kurtosis in empathic concern ($Zskewness=0.32$, $Zkurtosis=-0.27$), and both an unacceptable skewness and kurtosis in OT time 1 ($Zskewness=4.40$, $Zkurtosis=6.74$).

In the beginning the histogram of OT time 1 revealed a skewed distribution. But after the transformation of OT time 1 (LN_OTtime1) the skewness and kurtosis are much smaller ($Zskewness=0.21$, $Zkurtosis=0.53$), and the histogram shows a rather normally distributed curve (see figure 2). Thus, the LN_transformation was successful in transforming the skewed distribution into a nearly symmetric distribution.

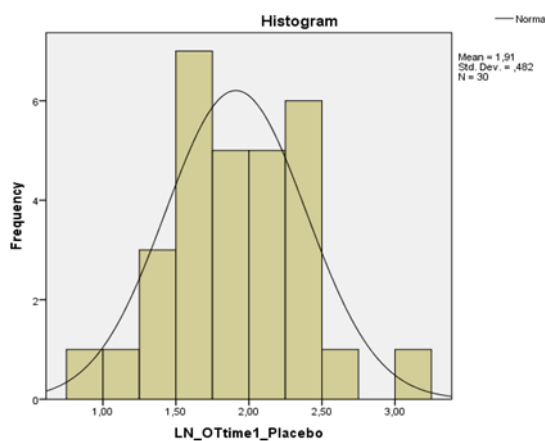


Figure 2. Histogram of LN_OT time 1.

Illustration of a normal curve.

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

The histogram from donations revealed a slightly right skewed distribution, since most values are concentrated on the left of the mean (see figure 3). The histogram with values of empathic concern indicates a rather normal distribution (see figure 4).

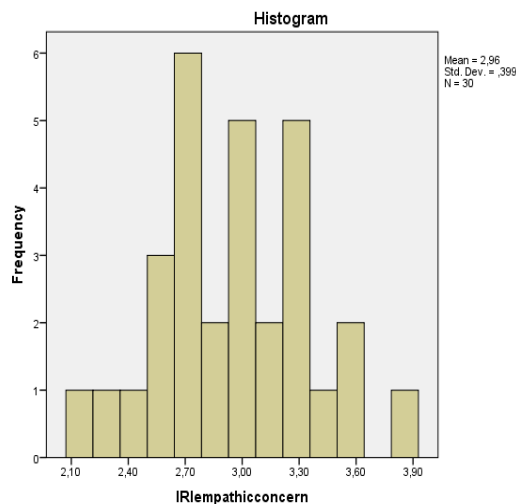
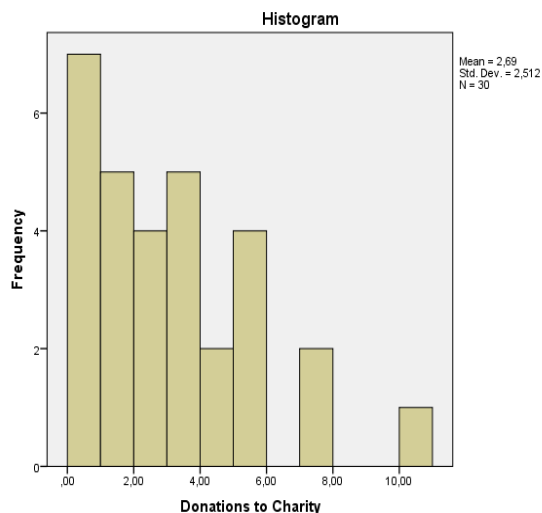


Figure 3. Histogram of donations to charity. Figure 4. Histogram of empathic concern. Illustration of a slightly skewed distribution. Illustration of a normal distribution.

Hypothesis tests

We sought to test a mediation model in which empathic concern (mediator) mediates the relationship between endogenous OT levels (predictor) and donations (outcome). Thus, according to this model, donations to charity can be explained by the influence of OT levels on empathic concern.

We conducted a simple regression analysis of OT time 1 (predictor) with empathic concern (outcome). The results reveal that OT time 1 does not significantly predict empathic concern and the prediction is negative ($\text{Beta} = -0.26$, $t(11.40) = -1.47$, $p = .15$). Thus, the second hypothesis of OT time 1 (predictor) being significantly related to empathic concern (mediator) was not confirmed.

To test the second hypothesis, we conducted another simple regression analysis of OT time 1 (predictor) with donations (outcome) to test the first condition. OT time 1 does not appear to significantly predict donations and the prediction is negative ($\text{Beta} = -0.23$, $t(2.69) = -1.30$, $p = .20$). Thus, the first hypothesis of OT time 1 being significantly related to donations was not confirmed.

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

A multiple regression analysis was conducted to test the third and fourth hypotheses. The findings show a low variance (0.03%) for donations can be accounted by empathic concern. There seems not to be a significant explanatory power of empathic concern and OT time 1 for donations ($F(2, 27) = 0.83$, $p = .44$, $R^2 = .001$). Empathic concern also does not seem to significantly predict donations ($Beta = -0.34$, $t(0.58) = -0.17$, $p = .86$). Therefore, the third hypothesis of empathic concern being significantly related to donations is refuted. Besides, OT time 1 also does not appear to significantly predict donations ($Beta = -0.24$, $t(1.26) = -1.27$, $p = .21$). Thus, the fourth hypothesis is not confirmed since in the first analysis OT time 1 was not a significant predictor. In conclusion, donations cannot be explained by the influence of OT time 1 on empathic concern, nor do donations seem to be predicted by OT time 1 itself.

Control variables tests

We conducted two independent sample t-tests to examine possible confounding effects of menstruation cycle and the use of the Pill.

An independent sample t-test was used to test if the mean scores between participants who took the Pill and the ones who did not were significantly different. There are no significant differences between the OT level means of pill users ($M = 6.8$) and non-pill users ($M = 5.7$), on OT time 1 ($t(28) = -0.65$, $p = .51$).

An independent sample t-test was used to test if the mean scores between participants classified in the follicular menstruation's phase and those in the luteal phase were significantly different. There were no significant differences between the follicular phase participants ($M = 6.22$) and the luteal phase participants ($M = 6.58$) on OT time 1 ($t(20) = -0.27$, $p = .78$). Altogether, there appear not to be confounding effects of menstruation cycle and use of the Pill on endogenous OT levels.

DISCUSSION

The aim of the study was to examine whether endogenous OT levels would enhance donating behaviour through increasing empathic concern. This study also examined possible confounding effects of oral contraceptives and menstruation cycle on endogenous OT levels. We tested the hypothesis of a mediation model, in which the amounts donated to charity would be at least partially explained by the influence of endogenous OT levels on empathic concern.

The findings did not confirm our hypothesis since multiple regression analyses revealed no significant predictive effects of endogenous OT levels on donating behaviour, no significant predictive effects of empathic concern on donating behaviour, and endogenous OT levels and empathic concern together did not significantly predict donating behaviour.

When testing for possible confounding effects of menstruation cycle and oral contraceptives on OT plasma concentration, the t-tests showed no significant differences in the mean scores between the participants who were taking oral contraceptives and those who did not. There were also no significant differences between the participants who were in the follicular menstruation's phase and those who were in the luteal phase. Thus, no confounding effects of these variables were found.

Justification of the null results to confirm the mediation model

Our study failed to demonstrate that endogenous OT levels affect donating behaviour through the modulating effect of empathic concern. An explanation for these results could be the existence of confounding effects of individual differences and features of situations, which may modify the influence of OT on empathy and prosocial behaviour. Below, the following features will be addressed: the influence of individual differences and features of situations, on empathy and prosocial behaviour.

For instance, De Dreu (2012) suggested that social context and individual differences in social-cognitive abilities modulate the way OT influences social behaviour. Regarding the social context, the researcher stated that prosociality only occurs when the demanded cooperation is in-group. It seems that OT promotes both trust and other-concern in in-group members, which leads to cooperation.

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

Therefore, when the charity recipient is described as less prosocial and untrustworthy or he/she is anonymous, OT does not influence trust and cooperation. Regarding to the expression of other-concern, individuals show high empathy and other concern in in-group members, especially when those in-group individuals show strong emotions such as sadness or embarrassment. Additionally, OT appears to up-regulate other-concern, to enhance the inference of others' emotions, and to motive fairness. OT also promotes favouritism in in-group members. In brief, De Dreu (2012) claimed that motivation towards cooperation through OT is parochial; since the peptide promotes in-group altruism by decreasing fear, rising trust and up-regulating empathic concern. In contrast, OT prevents cooperation with out-group members and threatening outsiders (Dreu, 2012).

In the same vein, Barraza et al (2011) studied the influence of social context. Their findings showed that participants had greater preferences for donating to the American Red Cross in comparison with the Palestinian Red Crescent Society. Thus, suggesting that OT may promote empathy and in turn, enhance prosocial behaviour to in-group favouritism and trustworthy members, and not to out-group and untrustworthy members (Barraza et al, 2011). In the current study donating behaviour was measured with donations to a child from Bangladesh, which is an out-group member since the participants were from The Netherlands. Therefore, the fact that we measured donating behaviour to an out-group member might have limited the effects of OT on donations. In a similar vein, it seems that the way men frame poverty may influence their willingness to donate to charity (Willer, Willem & Owens, 2015). Specifically, when poverty is framed as an issue that could affect one's own society and one's own life, then this individual may be more inclined to donate. But in this case, this concern about poverty comes from one's own self-interest. That only occurred in men who otherwise were not willing to donate due to low empathic concern about poverty (Willer et al, 2015).

Regarding the evidence about the existence of individual differences in sociability, it has been suggested that people with low social-cognition abilities seem to be less attuned to social cues, hypersensitive and interpret social cues negatively. It seems that those people are likely to be more affected by the prosocial effects of OT (De Dreu, 2012). In the same vein, Lumineta, Grynberga, Ruzetteb and Mikolajczak (2011) examined whether individuals with low emotional/social abilities benefit more from the prosocial effects of OT. Male participants received a randomly administration of OT or placebo, and they performed the Reading the Mind in the Eyes test, which assesses the ability to recognise complex emotions.

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

According to the participants' performance in this task, they were classified as individuals with low or high alexithymia, which is the inability to identify and verbally express emotions and feelings awareness, including a dysfunction in social attachment, and interpersonal relationships (Fitzgerald and Bellgrove, 2006). The findings revealed that individuals with low alexithymia performed equally well under both OT and placebo conditions. In contrast, individuals with high alexithymia performed better in OT condition. Thus, the social effects of OT, a part from depending on the social context, OT may also depend on the individual's personality. These findings imply that OT may have a stronger impact on less socially proficient individuals. Thus, this suggestion may explain why endogenous OT levels did not significantly predict donating behaviour in the participants in the present study since they were undergraduate female students who may probably be high socially proficient.

In brief, there is evidence of the existence of certain situational and individual features that may modulate the way OT influences prosocial behaviour. Therefore, we could hypothesize that OT could enhance empathy and in turn, promote donating behaviour; as long as the donating behaviour is directed to an in-group charity organization. We would also expect greater effects of OT on donating behaviour among more self-centered and low socially proficient participants.

Strength and weaknesses of the research

One of the greatest strengths of this study is the use of an emotional video to trigger empathic concern and in turn, donations to charity; since emotional videos are found to be more efficient than neutral videos when inciting to donate to charity (Barraza & Zak, 2009). Examining the prosocial effects of endogenous OT is also a strong point as most studies tested the influence of exogenous OT (e.g. Zak et al, 2007), probably because it may be easier to test the effects of OT when measuring externally administered OT. In addition, examining the endogenous effects of OT involves getting closer to what occurs in a natural setting. In contrast, exogenous OT cannot fully represent the natural and real effects of OT.

Measuring prosocial behaviour through donations to charity's task is also quite pioneering, since only a few studies have conducted this task (e.g. Barraza et al, 2011). Finally, most research in OT has been conducted in males to avoid possible confounding effects of menstruation cycle and use of oral contraceptives. This is the only study that recruited female participants to examine the prosocial effects of endogenous OT and at the same time, examined possible confounding effects of menstruation cycle and use of oral contraceptives.

Nevertheless, there are also some limitations in this study. An important weakness is that the current study assessed only the peripheral effects of OT since peripheral OT can be easily subtracted from blood samples, while more invasive spinal tap assays of cerebrospinal fluid are required to measure central OT. However, it is not known how peripheral and central OT are correlated since it is not known how much of the reported plasma levels crosses the blood-brain barrier. (Churchland & Winkielman, 2012). Normally there is a difference between the measured OT plasma (peripheral OT) levels and the OT levels measured in the ventricular cerebrospinal fluid (central OT) (Churchland & Winkielman, 2012). This means that the OT levels found in plasma are not equivalent to those found in cerebrospinal fluid. This fact needs to be taken into account when interpreting the results.

Recommendations for future Research

As discussed previously, the study did not examine some individual differences and situational features which might have played a role in modulating the relationship between OT, empathic concern and in turn, donations (Bartz et al, 2011). Specifically, this study used an out-group recipient of the donations to measure donating behaviour and that could have had influenced the lack of significance of the correlation between OT, degree of empathy and donations to charity; since there is evidence that prosocial behaviour may be greater among in-group charity members (Dreu, 2012). Thus, it would be useful to establish whether cooperation is enhanced when the recipient of the charitable organization is trustworthy and an in-group member in comparison with an out-group member recipient. In addition, the current study probably only included likely highly socially proficient students and not individuals with low social skills. Thus, it would be relevant to include low socially proficient individuals in the study since it appears that the prosocial impact of OT is greater among less socially proficient individuals (Declerck et al, 2014).

Another relevant matter, concerning the measure of OT, is that it is not known whether there is any difference between the prosocial effects between endogenous and exogenous OT. A review from Thomas (1992) suggests that exogenous OT may have a role in prosocial behaviour, whereas endogenous OT may influence social interaction. So, it would be interesting to examine the difference in the prosocial effects between endogenous and exogenous OT and whether either shows a stronger impact on prosocial behaviour (Thomas, 1992).

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

It would be advisable to test possible individual genetic divergences as there is also evidence that there are genetic individual differences that modulate the effects of OT on prosocial behaviour (Kumsta & Heinrich, 2012). It seems that these genes divergences are due to genetic individual differences in the genetic polymorphism for the OXTR (Israel et al, 2009). In line with these findings, Rodrigues, Saslow, Garcia, Johna & keltner (2009) claimed that this natural genetic variation of the effects of OT is related to different empathic and stress profiles. Thus, this genetic variation of OXTR somewhat may explain the individual differences in the way OT influences social behaviour and social cognition (Kumsta & Heinrich, 2012). To further our understanding, most recent evidence suggests that specific variants in the single nucleoid polymorphism of OT (rs2268498, rs237887, rs1042778, and rs2254298) have a direct impact on empathic concern and perspective taking and in turn, those OT genetic variants indirectly influence prosocial behaviour (Christ, Carlo & Stoltenberg, 2015). Concretely, it has been observed that those individual that carry the G/G genotype show greater empathic concern and in turn, engage more often in prosocial actions. So, what is new from this evidence is that these OT genetic variants may have an indirect influence on prosocial behaviour, which may be mediated by the direct effect of these polymorphisms on empathic concern and perspective taking (Christ et al, 2015). However, this finding does not support evidence from previous studies that suggest that the allele A may also play a role in promoting empathy and prosocial behaviour (Wu et al, 2012, cited by Christ et al, 2015).

Future studies should also include both males and females in the sample to examine possible gender divergences. For instance, Campbell et al (2008) observed gender differences in the effects of OT on the reactions to images of same-sex strangers. It appeared that greater OT levels stimulated agonistic facial expressions and decreased perception of friendliness in men, while in women this peptide stimulated affiliative facial expressions and increased perception of friendliness (Campbell, 2009). In a different vein, Barraza et al (2009) revealed that the association between OT and empathy was especially strong among females. In addition, it seems there may be gender differences in the expression and prosocial effects of certain OT's genetic polymorphisms, found to be related to prosocial behaviour (Christ, Carlo & Stoltenberg, 2015). Specifically, it has been observed that the effect of the G/G genotype on prosocial behaviour only occurs in males (Christ, Carlo & Stoltenberg, 2015).

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

Lastly, a moderating gender effect has been observed on the willingness to donate to charity, since in one study men showed lower empathy towards poverty which negatively affected their will to make a charity donation (Willer et al, 2015). This finding suggests that empathy may mediate these gender differences in charitable giving (Willer et al, 2015). Overall, these studies suggest the likely existence of gender differences in the effects of OT on empathy and prosocial behaviour. These findings persuade to improve our understanding about the existence of gender differences in prosocial behaviour.

It would also be useful to control for socioeconomic status levels to test whether the level of wealth influences generosity. Since it is likely that possessing a greater income may have psychological outcomes, such as making individuals more self-focused and as a result, less willing to help others (Vohs et al, 2006 cited in Barraza et al, 2011).

The small empathy scale range (from 1 to 4) used to evaluate the empathic concern levels might have not been able to include and represent the highest levels of empathy, as the participants from this study appeared to be highly empathic. Thus, we could expect that if the empathy range had been larger it could have had a stronger correlation with OT. Statistically, the larger is the range, the greater is the probability of having a stronger correlation. So, it would be interesting to test this suggestion.

To conclude, it is obvious that a large number of factors must be taken into account when assessing the influence of endogenous OT levels on degree of empathy and in turn on prosocial behaviour. Some of these factors include social context, individual differences in social cognition and genetic variables. Several other factors may also be relevant to study such as gender differences, socioeconomic status and differences in the prosocial effects between endogenous and exogenous OT levels.

This research would be important to know more about the mechanism underlying the relationship between OT levels, degree of empathy and in turn prosocial behaviour. It would be also useful for charity organizations to know what exactly triggers individuals to donate to charity. Lastly, it would be also relevant for interventions aimed at enhancing empathy and prosocial behaviour in both low socially proficient and prosocial individuals, to know what and how to increase perspective-taking and prosociality.

REFERENCES

- Abu-Akell, A., Palgi, S., Klein, E., Decety, J., & Shamay-Tsoory, S.S. (2015). Oxytocin increases empathy to pain when adopting the other but not the self-perspective. *Social Neuroscience*, 10 (1), 7-15.
- Atkinson, A.B., Backus, P.G., Micklewright, J., Pharoah, C., & Schnepf, S.V. (2012). Charitable giving for overseas development: UK trends over a quarter century. *Journal of Royal Statistical Society*, 175 (1):167–190
- Barraza, J.A., & Zak, P.J. (2009). Empathy toward Strangers Triggers Oxytocin Release and Subsequent Generosity. *Values, Empathy, and Fairness across Social Barriers: New York Academy of Science*, 1167: 182–189
- Barraza, J.A., McCough, E.M., Ahmadi, S., & Zak, P.J. (2011). Oxytocin infusion increases charitable donations regardless of monetary resources. *Hormones and Behavior*, 60, 148–151
- Bartz, J.A., Zaki, J., Bolger, N., & Ochsner, K.N. (2011). Social effects of oxytocin in humans: context and person matter. *Trends in Cognitive Sciences*, 15 (7), 301-309.
- Baumgartner, T., Heinrichs, M., Vonlanthen, A., Fischbacher, U., & Fehr, E. (2008). Oxytocin Shapes the Neural Circuitry of Trust and Trust Adaptation in Humans. *Neuron*, 58, 639–650.
- Campbell, A. (2008). Attachment, aggression and affiliation: The role of oxytocin in female social behavior. *Biological Psychology*, 77, 1–10.
- Campbell, A. (2010). Oxytocin and Human Social Behavior. *Personality and Social Psychology Review*, 14 (3): 281–295.
- Christ, C.C., Carlo, G., & Stoltenberg, S.F. (2015). Oxytocin Receptor (OXTR) Single Nucleotide Polymorphisms Indirectly Predict Prosocial Behavior through Perspective Taking and Empathic Concern. *Journal of Personality*, x, 1-10.
- Churchland, P.S., & Winkielman, P. (2012). Modulating social behavior with oxytocin: How does it work? What does it mean? *Hormones and Behavior*, 61, 392–399
- Davis, M. H. (1980). A multidimensional approach to individual differences in empathy. *The Journal Supplement Abstract Service; Catalog of Selected Documents in Psychology*, 10 (85), x-x.

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

- Declerck, C., Boone, C., & Kiyonari, T. (2014). The effect of oxytocin on cooperation in a prisoner's dilemma depends on the social context and a person's social value orientation. *Social Cognitive Affective Neuroscience*, 9, 802-809
- Domes, G., Heinrichs, M., Michel, A., Berger, C., & Herpertz, S.C. (2007). Oxytocin Improves "Mind-Reading" in Humans. *Society of Biological Psychiatry*, 61, 731-733
- Dreu, C.K.W. (2012). Oxytocin modulates cooperation within and competition between groups: An integrative review and research agenda. *Hormones and Behavior*, 61, 419-428
- Dunn, E.W., Aknin, L.B., & Norton, M.L. (2014). Prosocial Spending and Happiness: Using Money to Benefit Others Pays Off. *Current Directions in Psychological Science*, 23 (1), 41-47
- Eisenberg, N., Shea, C.L., Carlo, G., & Knight, G.P. (1991). Empathy-related responding and cognition: A "chicken and the egg" dilemma. Hillsdale, New Jersey, Hove and London: Lawrence Erlbaum Associates.
- Fitzgerald, M., & Bellgrove, M.A. (2006). The overlap between alexithymia and Asperger's syndrome. *Journal Autism Developmental Disorder*, 36 (4), 573-576.
- Hurlemann, R., Patin, A., Onur, O.A., Cohen, X.S., Baumgartner, T., Metzler, S., ... Kendrick, K.M. (2010). *The Journal of Neuroscience*, 30 (14), 4999-5007.
- Israel, S., Lerer, E., Shalev, I., Uzevovsky, F., Riebold, M., Laiba, L., ... Ebstein, R.P. (2009). The Oxytocin Receptor (OXTR) Contributes to Prosocial Fund Allocations in the Dictator Game and the Social Value Orientations Task. *Plosone*, 4 (5), 1-10.
- Kahneman, D., Knetsch, J.K., & Thaler, R.H. (1986). Fairness as a Constraint on Profit Seeking: Entitlements in the Market. *The American Economic Review*, 76 (4), 728-41.
- Kim, S.J., & Kou, X. (2014). Not all empathy is equal: how dispositional empathy affects charitable giving. *Journal of nonprofit & public sector marketing*, 26 (4), 312-334
- Kosfeld, M., Heinrichs, M., Zak, P.J., Fischbacher, U., & Fehr, E. (2005). Oxytocin increases trust in humans. *Nature Publishing Group*, 435, 673-676.
- Kumsta, R., & Heinrich, M. (2012). Oxytocin, stress and social behavior: neurogenetics of the human oxytocin system. *Current Opinion in Neurobiology*, 23, 1-6

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

Kurzban, R., Burton-Chellew, M.N., & West, S.A. (2015). The Evolution of Altruism in Humans. *The Annual Review of Psychology*, 66, 10.1–10.25

Lumineta, O., Grynberga, D., Ruzetteb, D., & Mikolajczak, M. (2011). Personality-dependent effects of oxytocin: Greater social benefits for high alexithymia scorers. *Biological Psychology*, 36 (4), 401–406

Macdonald, M.D., Macdonald, R.N. (2010). The Peptide That Binds: A Systematic Review of Oxytocin and its Prosocial Effects in Humans. *Harvard Review Psychiatry*, 18, 1-21.

Raddke, S., & Bruijn, E.R.A. (2012). The other side of the coin: oxytocin decreases the adherence to fairness norms. *Frontiers in Human Neuroscience*, 6 (193), 1-7.

Rodrigues, S.M., Saslow, R.S., Garcia, G., Johna, P.J & Keltner, D. (2009). Oxytocin receptor genetic variation relates to empathy and stress reactivity in humans. *Proceedings of the National Academy of Sciences of the United States of America*, 106 (50), x-x.

Salonia, A., Nappi, R.E., Pontillo, M., Daverio, R., Smeraldi, A., Brigantia, ... Montorsia, F. (2005). Menstrual cycle-related changes in plasma oxytocin are relevant to normal sexual function in healthy women. *Hormones and Behavior*, 47 (2), 164–169

Stock, S., Silver, M., & Uvnäs-Moberg, K. (1989). Elevated plasma levels of oxytocin in women taking low-dose oral contraceptives. Identification of the plasma oxytocin with high performance liquid chromatography. *Acta Obstet Gynecology Scand*, 68 (1), 75-8

Sze, J.A., Gyurak, A., Goodkind, M.S., & Levenson, R.W. (2011). Greater Emotional Empathy and Prosocial Behavior in Late Life. *Emotion*, 12 (15), 1129–1140

Thomas, R.I (1992). Oxytocin - a neuropeptide for affiliation: evidence from behavioral, receptor autoradiographic, and comparative studies. *Psychoneuroendocrinology*, 17(1), 3-35

Trivers, R.L. (1971). The evolution of reciprocal altruism. *The quarterly review of psychology*, 46, (1): x-x.

Vohs, D.K., Mead, N.L., Goode, M.R. (2006). The psychological consequences of money. *Science*, 314, 1154–1156.

Walter, H. (2012). Social Cognitive Neuroscience of Empathy: Concepts, Circuits, and Genes. *Emotion Review*, 4, 9–17

Is Donating Behaviour Explained by the Influence of Oxytocin on Empathy?

Wu, N., Li, Z., & Su, Y. (2012). The association between oxytocin receptor gene polymorphism (OXTR) and trait empathy. *Journal of Affective Disorders*, 138 (3), 468–472.

Zak, P.J., Stanton, A.A., & Ahmadi, S. (2007). Oxytocin Increases Generosity in Humans. *PlosOne*, 2 (11), 1-5.