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Oxytocin, Trust, and Trustworthiness: The Moderating Role of Music

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Evidence has indicated that the neuroactive hormone oxytocin is essential for prosocial behavior, particularly trust. Exogenous administration of oxytocin has been shown to increase trust in humans. However, one may argue that, except the administration of oxytocin in nonhealthy patient groups (e.g., those with autism or anxiety disorders) to alleviate negative symptoms, external administration of oxytocin has little relevance in normal life. Music, a ubiquitous stimulus in human society, has been shown to increase oxytocin in medical therapy scenarios. Considering this evidence, we conducted a trust game experiment with a sample of healthy humans and investigated music's effects on the (a) trustor's oxytocin levels (blood sample measurement), (b) investment amount (trust behavior measurement), and (c) perception of the other player's trustworthiness (self-report). The results of our exploratory study show that an increase in oxytocin levels over 40 trials in a trust game increased perceived trustworthiness in the no-music condition but had no impact on investment amount (i.e., trust behavior). Moreover, music had no effect on oxytocin, trust behavior, or perceived trustworthiness. Thus, unlike prior research showing that music listening may increase self-reported trust in another individual, in the present study we found no effect of music on trust (on either a physiological or behavioral level). We surmise that this finding is a result of both the type of music played during task execution and music preferences. Thus, future research must carefully manipulate music features (e.g., pitch, rhythm, timbre, tempo, meter, contour, loudness, and spatial location) and consider a listener's music preferences to better understand music's effects on physiological, perceived, and behavioral trust.

Keywords: hormone, oxytocin, music, trust, trust game

There has been mounting evidence that besides parturition and lactation, the neurohypophysis hormone oxytocin is crucial for prosocial behavior, including maternal attachment and pair bonding. Hence, oxytocin has been linked to approach behavior in both animals and humans (Donaldson & Young, 2008). Consistent with this finding, evidence has suggested that oxytocin is related to human trust behavior. Experimental research (Zak, Kurzban, & Matzner, 2004; Zak, Kurzban, & Matzner, 2005) found that, based on the trust game, oxytocin levels were significantly elevated in participants (trustees) who received a signal of trust (operationalized via the amount of money sent by the trustor) relative to a random monetary transfer; moreover, that research found that trustees who received an intentional trust signal returned significantly more to the trustor if compared to a random monetary transfer. Those findings suggest that perception of a trust signal may increase *endogenous* oxytocin levels, and this may result in reciprocation of trust (i.e., a trustee turns out to be trustworthy). In another trust game

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experiment, Kosfeld, Heinrichs, Zak, Fischbacher, and Fehr (2005) administered either oxytocin or a placebo to trustors via nasal spray. Oxytocin significantly increased the trustors' trust into the trustees. Thus, that study shows that *exogenously* administered oxytocin may increase trust in social interaction scenarios. It is important to note that oxytocin does not cross the blood–brain barrier, though there is evidence from nonhuman primate studies, as well as some weak evidence from human studies, that oxytocin in blood is positively correlated with oxytocin in the central nervous system (measured in cerebral spinal fluid; for details, see Dal Monte, Noble, Turchi, Cummins, & Averbeck, 2014).

In a more recent study, Ebert et al. (2013) replicated the Kosfeld et al. (2005) findings in healthy participants; however, contrary effects were found in borderline personality disorder patients. In the latter group, oxytocin had a trust-lowering effect that correlated with patients' history of childhood trauma. Baumgartner, Heinrichs, Vonlanthen, Fischbacher, and Fehr (2008), in another study, demonstrated that repeated betrayal of trust did not deteriorate trust behavior after intranasal oxytocin administration, whereas trust decreased in the placebo condition. With respect to sex differences, Yao et al. (2014) reported that oxytocin makes female, but not male, individuals less forgiving following betrayal of trust. Consistent with those findings, results of a brain-imaging study with trust-varying stimuli showed significant activation differences between men and women in trust-related brain regions that are dense in oxytocin receptors, such as striatal areas (Riedl, Hubert, & Kenning, 2010). A more complete analysis of oxytocin studies in the trust domain can be found in a recent review article (Riedl & Javor, 2012). Of importance, despite the presented evidence that oxytocin is related to human trust behavior, it has been argued that this relationship is not yet well understood. In a recent critical review of empirical research, Nave, Camerer, and McCullough (2015) concluded that "the cumulative evidence does not provide robust convergent evidence that human trust is reliably associated with OT [oxytocin] (or caused by it)" (p. 772).

Even though the relationship between oxytocin and human trust behavior is still an open question, one may argue that a pharmacological challenge like intranasal oxytocin intake constitutes a profound intervention in the body's equilibrium. Indeed, oxytocin treatment has been suggested to have implications for at least patients suffering from disturbed social behavior such as autism (e.g., Andari et al., 2010) or social anxiety disorder (e.g., Labuschagne et al., 2010). It is important to note that in the normal nonpsychopathological range of behavior it has been shown that trust behavior exhibits great variability and that that variability may also be related to differences in endogenous oxytocin levels (Riedl & Javor, 2012). This leads to the research question of this study, namely whether environmental stimuli can trigger trust behavior by increasing endogenous oxytocin levels. This study tests that through music. Music is an omnipresent stimulus in human society. It is well known that companies influence consumer behavior by music and that this influence is typically mediated by mood (for a review, see Garlin & Owen, 2006). It is not unlikely that music's effect on outcome variables such as shopping behavior is mediated by not only mood but also other factors, particularly trust perceptions. However, whether this is the case or not is currently unknown.

Against that background of previous research, the question arises whether music affects endogenous oxytocin release in a listener, which, in turn, may affect trust behavior. To the best of our knowledge, no other study has investigated this question. The only study that touches on this specific topic was carried out with a sample of convalescent people (Nilsson, 2009).[1] Specifically, that study evaluated the effect of bed rest with music on relaxation among patients who had just undergone heart surgery. A total of 40 patients who were at the time undergoing "open coronary artery bypass grafting and/or aortic valve replacement surgery" (Nilsson, 2009, p. 2153) were randomly allocated to one of two experimental conditions: music listening during bed rest ($n = 20$) or bed rest only ($n = 20$; the music was "soft, relaxing,

[1] In this context, we also mention a study conducted by Grape, Sandgren, Hansson, Ericson, and Theorell (2002). This study "explored the possible beneficial effects of singing on well-being" (p. 65). Although singing and listening to music (as investigated in our study) are different things, both are musical activities. Hence, it is interesting that Grape et al. reported that serum oxytocin concentrations increased significantly after a 45-min singing lesson (measurement took place before and 30 min after the lesson).

and included different melodies of 60 to 80 beats per minute [bpm] and was for 30 minutes with a volume of 50–60 dB," Nilsson, 2009, p. 2155). Relaxation was measured during bed rest the day after surgery by assessing multiple parameters, including plasma oxytocin and subjective relaxation levels, among others. The results indicated that in the music group oxytocin increased significantly in contrast to the control group and that self-reported relaxation also increased significantly more in the music group than in the control group. Thus, that study suggests that listening to music during bed rest after open-heart surgery may have positive effects on relaxation, on both a physiological (oxytocin) and a perceptual (self-reported) level.

However, it may be argued that a population that had just undergone surgery is likely to exhibit different physiological and psychological patterns in comparison to a normal and healthy population. Hence, in this exploratory study we investigated with a "discovery" sample whether, and if so how much, external music stimuli affect oxytocin levels in healthy participants in a trust game context and whether a potential physiological music effect also influences trust perceptions and trust behavior.

Method

This study was approved by the responsible local ethics committee in Upper Austria. All participants gave written informed consent. A licensed medical doctor (the second author of this article) performed intravenous blood sample collections, as well as supervised all experimental sessions.

Participants

Participants were recruited based on the university e-mail list and consisted of 30 right-handed male graduate- and doctoral-level students who had no history of neurological or psychiatric illnesses and who took no medication at the time the experiment was conducted. There was no significant age difference between the treatment (music: $n = 15$, mean age = 27.2, $SD = 5.3$) and control (no music: $n = 15$, mean age = 26.1, $SD = 6.2$) groups, $F(1, 28) = .256$, $p = .617$.

Procedure

Participants were told that the experiment consists of an economic game during which blood samples would be taken. We avoided the term *trust game* (Berg, Dickhaut, & McCabe, 1995) to rule out potential physiological and behavioral effects. Specifically, the participants were told that (a) both players would receive an initial endowment of €10, (b) they would play only the first move of the game (i.e., in the role of the trustor), (c) the amount they give to the other player would be multiplied by six so that the other player would receive six times what they were giving this other player, and (d) the other player could then reciprocate by paying back any amount. For example, if a participant invested €10 (this would be the total initial endowment), then the other player would receive €60, of which this other player could then send back any amount in between €0 and €70 to the participant (€70 = €10 [initial endowment] + €60 [received amount]). Each participant also rated post hoc the trustworthiness of each stimulus (faces and nicknames; explained next) on a 7-point-Likert scale.

In our version of the trust game, the second move was actually not played, to rule out effects such as learning or anger (due to eventual unfair reciprocation). Thus, participants had to make only the initial investment decision, that is, the first move in the game. As a consequence, we investigated initial trust, and not knowledge-based trust, in this study. Initial trust is the trust someone has in a stranger before having any interaction experience with the person. Knowledge-based trust, in contrast, is trust that emerges through engagement with the other person. The participants' playing partners were presented on a computer screen in the form of (a) face pictures (simulating real-world face-to-face interaction) and (b) male nicknames without any further information (simulating interaction in anonymous Internet environments).

Participants were informed that their compensation for the experiment would be the outcome of one randomly selected round out of all 40 rounds played during the experiment, but in fact, all participants received the same amount (€35). The faces for the experiment were taken from an existing database for which face trustworthiness has been prerated (Lundqvist, Flykt, & Öhman, 1998; Oosterhof & Todorov, 2008).

Nicknames were created for this study based on existing male Internet chat room nicknames. The protocol consisted of both 10 trustworthy and 10 untrustworthy faces and the same number of trustworthy and untrustworthy nicknames. Each participant played 40 rounds during the experiment, of which 20 were against "faces" and 20 against "nicknames." Faces and nicknames were presented in blocks of 20 rounds. The experimental protocol is illustrated in Figure 1.

After briefing the 30 participants, we randomly assigned them to the two experimental groups, with an equal number of participants in each group. Next, a catheter to collect multiple blood samples (BSs) was inserted into the arm of the participant. The first blood sample, BS_1, was taken 10 min after insertion of the catheter. In the treatment group, music was played in the background while the participant played the trust game. The music playing, which started after BS_1 had been taken, was Schubert's "Marche Militaire" in D major (stimulus administration: via loudspeakers at a volume of 50–60 dB). In the control group, no music was played. Six blood samples (BS_1, BS_2, BS_3, BS_4, BS_5, BS_6) were taken during the experiment.

Blood samples were taken before the first round of the game (BS_1), after every 10 rounds of the game (BS_2, BS_3, BS_4, BS_5), and 10 min after the end of the trust game (BS_6). After playing all rounds of the trust game, the participants were asked (a) their age and whether they (b) recognized the music if they were in the treatment group, (c) liked the music, and (d) whether they knew the musical piece before the experiment (i.e., familiarity). Additionally, (e) disposition to trust was measured based on an existing instrument (Gefen, 2000). Also, (f) each participant rated post hoc the trustworthiness of all faces and nicknames on a 7-point-Likert scale.

Hormone Analyses and Sample Collection

Blood samples were collected through the catheter into prechilled ethylenediaminetetraacetic acid tubes and kept cold during every step of processing. Blood samples were immediately cold-centrifuged at 1,600 g for 15 min at 4 °C. Plasma was then transferred into chilled tubes and frozen at −80 °C until assay. Extraction of peptides from plasma as well as fluorescent immunoassay analyses of the samples were performed following the manufacturer protocol in the laboratory of the Department of Psychology, University of Bonn, using the oxytocin fluorescent immunoassay kit developed by the company Phoenix Pharmaceuticals (Burlingame, California). The inter- and intraassay co-

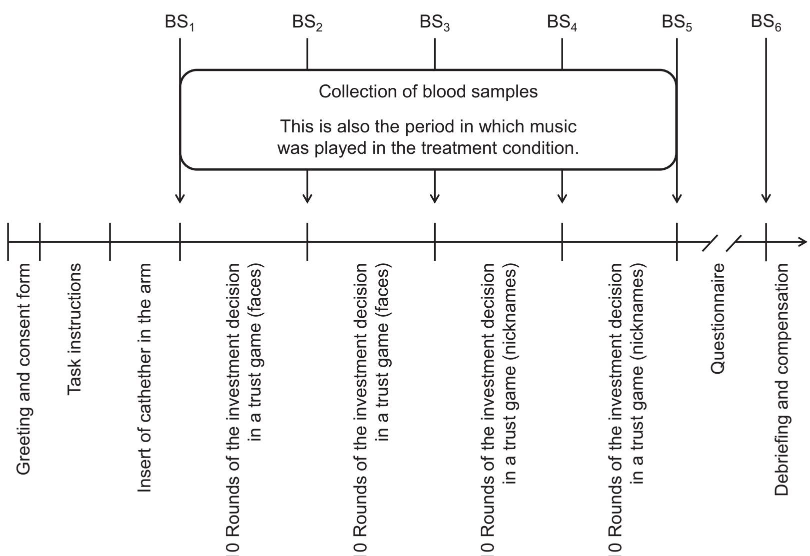

Figure 1. Experimental protocol. BS = blood sample. This protocol shows the experimental activities in sequential order (from left to right).

efficients of variability were <15% and <10%, respectively. All experimental sessions were conducted between 9.00 a.m. and 1.00 p.m.

Statistical Analyses

The effects of music on trusting behavior, the perceived trustworthiness of the other players, and oxytocin were analyzed by means of three separate repeated-measures analyses of variance (ANOVAs) with music (music or no music) as the between-subjects factor. In the respective analyses, trust behavior (four levels: Faces 1–10, Faces 11–20, Nicknames 1–10, Nicknames 11–20), perceived trustworthiness (four levels: Faces 1–10, Faces 11–20, Nicknames 1–10, Nicknames 11–20), and oxytocin levels (six time points of measurement) constituted the within-subject factor. Moreover, composite trust and trustworthiness scores were computed by summing up the responses of all 40 trials. These composite scores were tested for significant group difference (music or no music) by means of ANOVAs.

In an additional analysis, individual change of oxytocin over time was assessed by calculating a linear fit for each participant based on the person's respective six oxytocin values. The regression coefficients (beta weights [*b*s], slope of the regression line) provide information on the individual oxytocin-level changes across the experiment. Mean regression coefficients were compared between the experimental conditions (by means of ANOVA) and correlated with scores of trust and trustworthiness.

Before we report our results, we stress that the present study is exploratory in nature. Because of the relatively small sample size of 30 participants ($n = 15$ in the music condition and $n = 15$ in the no-music condition), replication studies are needed. This need for replications is independent of whether one reports statistically significant effects.

Results

Because it is known that oxytocin levels decrease during the day, showing higher levels in the morning and lower levels in the evening, two factors might counteract this natural oxytocin drop in the current experiment: the trust game and the experimental manipulation (i.e., listening to music).

On a descriptive level, results showed higher oxytocin levels across all six time points of measurement in the no-music condition when compared to the music condition (see Figure 2). However, the results of a repeated-measures analysis of variance yielded neither significant main effects of group, $F(1, 28) = 1.93$, $p = .176$, and time, $F(3.075, 86.090) = .692$, $p = .630$, nor a significant Time × Group interaction effect, $F(3.075, 86.090) = 1.74$, $p = .164$.[2] The insignificant statistical results may be the consequence of the relatively small sample consisting of only 15 participants each in the experimental and treatment groups. The effect size of the Time × Group interaction was a partial eta-square of 5.8%, suggesting a noticeable difference in measured oxytocin level change between the two experimental groups.

To quantify changes of oxytocin over time, we calculated a linear fit for each participant. The regression coefficients (beta weights [*b*s], slope of the regression line) provide information on the oxytocin level changes during the experiment. As expected based on the results of the repeated-measures analysis of variance, the slopes in the two experimental conditions did not differ significantly, $F(1, 29) = 1.13$, $p = .298$, although an increase in oxytocin over time was observable in the music condition ($b = .074$), whereas oxytocin levels decrease in the no-music condition ($b = -1.280$; see Figure 2).

However, we found significant correlations between the oxytocin slope and measures of trustworthiness but only in the no-music condition. Here the oxytocin slope was significantly correlated with trustworthiness of faces ($r = .550$, $p = .023$), nicknames ($r = .580$, $p = .023$), and the trustworthiness total scale (con-

[2] Both groups showed no significant differences in measures of trust (behavioral measure: investment amount in the trust game) and trustworthiness (7-point-Likert scale): trust faces ($M_{\text{no music}} = 86.067$, $SD = 28.273$; $M_{\text{music}} = 98.400$, $SD = 26.216$), $F(1, 28) = 1.54$, $p = .226$; trust nicknames ($M_{\text{no music}} = 108.267$, $SD = 36.916$; $M_{\text{music}} = 128.000$, $SD = 30.308$), $F(1, 28) = 2.56$, $p = .121$; trust total ($M_{\text{no music}} = 194.333$, $SD = 60.636$; $M_{\text{music}} = 226.400$, $SD = 49.838$), $F(1, 28) = 2.50$, $p = .125$; trustworthiness faces ($M_{\text{no music}} = 76.733$, $SD = 13.150$; $M_{\text{music}} = 80.133$, $SD = 12.794$), $F(1, 28) = 0.52$, $p = .479$; trustworthiness nicknames ($M_{\text{no music}} = 91.867$, $SD = 17.999$; $M_{\text{music}} = 102.600$, $SD = 13.378$), $F(1, 28) = 3.44$, $p = .074$; trustworthiness total ($M_{\text{no music}} = 168.600$, $SD = 27.959$; $M_{\text{music}} = 182.733$, $SD = 20.225$), $F(1, 28) = 2.52$, $p = .124$.

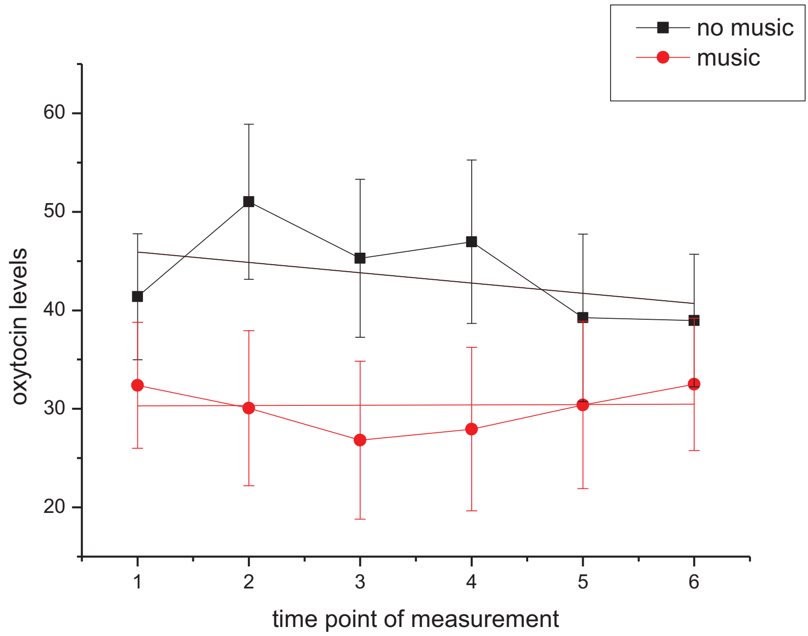

Figure 2. Oxytocin levels (pg/ml) in the treatment (music) and control (no music) groups across the six time points of measurement. Error bars indicate standard error of the means. See the online article for the color version of this figure.

taining faces and nicknames; $r = .632$, $p = .011$). There were consistently positive correlations between the oxytocin slope and trust in the no-music condition, although these correlations were not statistically significant. It is interesting that the correlations between oxytocin slope and measures of trust and trustworthiness were all negative, but not significant, in the music treatment condition.

Discussion

Based on previous studies that demonstrated the effects of oxytocin on trust and the trust elevating effects of music, this exploratory study used a trust game based on healthy participants to investigate the effects of music versus no music on endogenous oxytocin levels, trust behavior, and perceived trustworthiness of the other players. Despite the absence of a significant effect of music on oxytocin levels, trust, or trustworthiness in a between-subjects design, individual changes in oxytocin levels during the trust game were related to trustworthiness ratings. However, this effect was observable in only the no-music condition. Thus, music had no significant effect on oxytocin (yet, the effect size was not negligible), behavioral trust, and perceived trustworthiness. This result may seem inconsistent with results of prior research that showed that listening to music may increase self-reported trust in another individual (Anshel & Kipper, 1988).

However, because the *type of music* used in our study and in the prior study (Anshel & Kipper, 1988) differed significantly (Schubert's "Marche Militaire" in D major in the present study [i.e., classical music with no lyrics] vs. "popular Israeli songs," p. 149), this stimulus difference could have caused the difference in results. We do not know what songs exactly were played in the Anshel and Kipper (1988) study, but "Marche Militaire" is an invigorating martial music piece, potentially reducing oxytocin levels.[3] Our argument is based on evidence showing that music genre may strongly affect the consequences of music (e.g., Freeman, 2000). Music is characterized by many

[3] Possibly, the martial nature of the music, and the implied antisocial behavior of armies, may induce participants to be less social than they might normally be.

features, including pitch, rhythm, timbre, tempo, meter, contour, loudness, and spatial location (e.g., Levitin & Tirovolas, 2009). These features affect how music is perceived, as well as its effects. As an example, Gomez and Danuser (2007) demonstrated that perception of different musical features leads to significant differences in (a) physiological parameters such as respiration, skin conductance, and heart rate and (b) self-reported pleasantness and arousal.

Against the background of those conclusions, most likely musical features and their perception by the listener produce music's trust effects. Thus, future research with careful manipulation of music features is needed to better understand the effects of music on trust.

The positive association between oxytocin changes (i.e., increases across the experiment) and trustworthiness indicates that the neurohypophysis hormone is likely to promote feelings of trustworthiness when confronted with social interaction partners. Probably these prosocial feelings are blurred by the individual differences in the perception of the music being played (here classical music, which is rather old-fashioned to the young participants). Thus, future studies should consider *music preference.*[4] Of importance, previous research has shown that musical preference may significantly affect music's physiological effects. Specifically, a study by Vanderark and Ely (1993) revealed that musical preference significantly influenced listeners' cortisol response. Because cortisol and oxytocin have antagonistic effects (e.g., Ditzen et al., 2009; Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003), careful consideration of a listener's music preference, in addition to manipulation of music features, is indispensable to develop a clear picture on music's effects on trust.

Conclusion

The direction and magnitude of the effects in this study suggest that the relationship between music, oxytocin, trusting behavior, and trustworthiness is complex. An increase in oxytocin levels over 40 trials in a trust game was associated with an increase in the perceived trustworthiness of interaction partners in the no-music condition but had no apparent impact on trust behavior. Moreover, music had no effect on oxytocin, trust behavior, or perceived trustworthiness. Future research should examine the influence of musical genres and other musical features, as well as how these are perceived by the participants, on oxytocin, trustworthiness perceptions, and behavioral trust.

[4] In the present study, we asked participants in the music condition ($n = 15$) after playing all rounds of the trust game whether they liked the music (yes: 13, no: 2). It follows that there is too little variance in data to determine possible preference effects on outcome variables. We recommend that future studies assess music preference in a pretest so that enough variance in data is likely to exist in the main study. Moreover, we recommend using an ordinal scale to measure music preference in future studies.

References

Andari, E., Duhamel, J.-R., Zalla, T., Herbrecht, E., Leboyer, M., & Sirigu, A. (2010). Promoting social behavior with oxytocin in high-functioning autism spectrum disorders. *PNAS: Proceedings of the National Academy of Sciences of the United States of America, 107,* 4389–4394. http://dx.doi.org/10.1073/pnas.0910249107

Anshel, A., & Kipper, D. A. (1988). The influence of group singing on trust and cooperation. *Journal of Music Therapy, 3,* 140–155.

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. http://dx.doi.org/10.1016/j.neuron.2008.04.009

Berg, J., Dickhaut, J., & McCabe, K. (1995). Trust, reciprocity, and social history. *Games and Economic Behavior, 10,* 122–142. http://dx.doi.org/10.1006/game.1995.1027

Dal Monte, O., Noble, P. L., Turchi, J., Cummins, A., & Averbeck, B. B. (2014). CSF and blood oxytocin concentration changes following intranasal delivery in macaque. *PLoS ONE 9*(8), e103677.

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

Donaldson, Z. R., & Young, L. J. (2008, November 7). Oxytocin, vasopressin, and the neurogenetics of sociality. *Science, 322,* 900–904. http://dx.doi.org/10.1126/science.1158668

Ebert, A., Kolb, M., Heller, J., Edel, M. A., Roser, P., & Brüne, M. (2013). Modulation of interpersonal trust in borderline personality disorder by intranasal oxytocin and childhood trauma. *Social Neuroscience, 8,* 305–313. http://dx.doi.org/10.1080/17470919.2013.807301

Freeman, W. J. (2000). A neurobiological role of music in social bonding. In N. W. Merkur & S. Brown (Eds.), *The origins of music* (pp. 411–424). Cambridge, MA: MIT Press.

Garlin, F. V., & Owen, K. (2006). Setting the tone with the tune: A meta-analytic review of the effects of background music in retail settings. *Journal of Business Research, 59,* 755–764. http://dx.doi.org/10.1016/j.jbusres.2006.01.013

Gefen, D. (2000). E-commerce: The role of familiarity and trust. *Omega: The International Journal of Management Sciences, 28,* 725–737.

Gomez, P., & Danuser, B. (2007). Relationships between musical structure and psychophysiological measures of emotion. *Emotion, 7,* 377–387. http://dx.doi.org/10.1037/1528-3542.7.2.377

Grape, C., Sandgren, M., Hansson, L.-O., Ericson, M., & Theorell, T. (2002). Does singing promote well-being? An empirical study of professional and amateur singers during a singing lesson. *Integrative Physiological & Behavioral Science, 38,* 65–74. http://dx.doi.org/10.1007/BF02734261

Heinrichs, M., Baumgartner, T., Kirschbaum, C., & Ehlert, U. (2003). Social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress. *Biological Psychiatry, 54,* 1389–1398. http://dx.doi.org/10.1016/S0006-3223(03)00465-7

Kosfeld, M., Heinrichs, M., Zak, P. J., Fischbacher, U., & Fehr, E. (2005, June 2). Oxytocin increases trust in humans. *Nature, 435,* 673–676. http://dx.doi.org/10.1038/nature03701

Labuschagne, I., Phan, K. L., Wood, A., Angstadt, M., Chua, P., Heinrichs, M., . . . Nathan, P. J. (2010). Oxytocin attenuates amygdala reactivity to fear in generalized social anxiety disorder. *Neuropsychopharmacology, 35,* 2403–2413. http://dx.doi.org/10.1038/npp.2010.123

Levitin, D. J., & Tirovolas, A. K. (2009). Current advances in the cognitive neuroscience of music. *Annals of the New York Academy of Sciences, 1156,* 211–231. http://dx.doi.org/10.1111/j.1749-6632.2009.04417.x

Lundqvist, D., Flykt, A., & Öhman, A. (1998). Karolinska Directed Emotional Faces [Database of standardized facial images]. Stockholm, Sweden: Psychology Section, Department of Clinical Neuroscience, Karolinska Institute.

Nave, G., Camerer, C., & McCullough, M. (2015). Does oxytocin increase trust in humans? A critical review of research. *Perspectives on Psychological Science, 10,* 772–789.

Nilsson, U. (2009). Soothing music can increase oxytocin levels during bed rest after open-heart surgery: A randomised control trial. *Journal of Clinical Nursing, 18,* 2153–2161. http://dx.doi.org/10.1111/j.1365-2702.2008.02718.x

Oosterhof, N. N., & Todorov, A. (2008). The functional basis of face evaluation. *PNAS: Proceedings of the National Academy of Sciences of the United States of America, 105,* 11087–11092. http://dx.doi.org/10.1073/pnas.0805664105

Riedl, R., Hubert, M., & Kenning, P. (2010). Are there neural gender differences in online trust? An fMRI study on the perceived trustworthiness of eBay offers. *Management Information Systems Quarterly, 34,* 397–428.

Riedl, R., & Javor, A. (2012). The biology of trust: Integrating evidence from genetics, endocrinology, and functional brain imaging. *Journal of Neuroscience, Psychology, and Economics, 5,* 63–91. http://dx.doi.org/10.1037/a0026318

VanderArk, S. D., & Ely, D. (1993). Cortisol, biochemical, and galvanic skin responses to music stimuli of different preference values by college students in biology and music. *Perceptual and Motor Skills, 77,* 227–234. http://dx.doi.org/10.2466/pms.1993.77.1.227

Yao, S., Zhao, W., Cheng, R., Geng, Y., Luo, L., & Kendrick, K. M. (2014). Oxytocin makes females, but not males, less forgiving following betrayal of trust. *International Journal of Neuropsychopharmacology, 17,* 1785–1792. http://dx.doi.org/10.1017/S146114571400090X

Zak, P. J., Kurzban, R., & Matzner, W. T. (2004). The neurobiology of trust. *Annals of the New York Academy of Sciences, 1032,* 224–227. http://dx.doi.org/10.1196/annals.1314.025

Zak, P. J., Kurzban, R., & Matzner, W. T. (2005). Oxytocin is associated with human trustworthiness. *Hormones and Behavior, 48,* 522–527. http://dx.doi.org/10.1016/j.yhbeh.2005.07.009

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