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BRIEF REPORT

Oxytocin Modulates Charismatic Influence in Groups

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Charismatic leaders have had tremendous effects on the fortunes and fates of individuals and societies across the world. Via verbal and nonverbal signaling, such leaders form profound emotional bonds with followers. Despite evidence for its powerful effects, we know very little about what facilitates the charismatic relationship. Here, we argue that the neuropeptide oxytocin (OT), known to be implicated in parent–child attachment, also enhances the effects of charismatic leaders in groups. In a double-blind placebo-controlled study, we administered intranasal OT to participants, led by a confederate trained to exhibit charisma, and monitored participants' responses to the confederate's signaling while leading a group task. We found that OT enhanced the effects of 3 common manifestations of charismatic signaling—verbal behaviors, nonverbal behaviors, and followers' perceptions of the confederate's charisma—on classic outcomes of charismatic influence. Specifically, participants under OT showed more expressions of positive affect and mimicry of the leader in response to the confederate's signaling, and perceptions of the confederate's charisma had stronger effects on participants' willingness to trust each other. These findings extend the role of OT beyond the attachment bond to explain leader–follower relationships, shed light on the role of neuroendocrine factors in contagion processes in groups, and support the social saliency perspective of OT. We note, however, that because charisma was not manipulated, we had reduced control over the confederates' specific behaviors. We address this limitation in the Discussion, point to broader theoretical implications of our work, and offer ideas for future research.

Keywords: charismatic influence, groups, oxytocin

Supplemental materials: http://dx.doi.org/10.1037/xge0000375.supp

What is behind the motivation of individuals and groups to emotionally endorse, trust, and rally around a certain leader? Charismatic leaders are unique in that they rely on symbolic use of emotions to facilitate a profound bond with followers, which fascinated eminent scholars such as Sigmund Freud and Max Weber (Weber, 1947). Through this relationship, such leaders harness individuals' effort to identify with and exert extra effort toward achieving collective goals. They are thus unlike other leaders who provide direction and rewards (cf. Antonakis, Bastardoz, Jacquart, & Shamir, 2016; Bass, Avolio, Jung, & Berson, 2003; House, 1977).

Considered a universal form of influence, charismatic leadership has been most recently defined as "values-based, symbolic, and emotion-laden leader signaling" (Antonakis et al., 2016, p. 303; Bass, 1997; Kirkpatrick & Locke, 1996). Through both verbal and nonverbal signals, leaders convey ideals, exude confidence, and express optimism, all of which facilitate exceptional relationships with followers (Howell & Shamir, 2005; Shamir, House, & Arthur, 1993). Inspired followers, in turn, perceive the leader as a role model and consequently emulate and mimic the leader's behaviors, display positive affect toward the leader, and extend sentiments they have for the leader toward other members of their group (Erez, Misangyi, Johnson, LePine, & Halverson, 2008; House, 1977; Shamir et al., 1993).

Unfortunately, despite decades of investigation, we know very little about the factors that facilitate the charismatic relationship (Avolio, Walumbwa, & Weber, 2009). Furthermore, existing re-

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Both authors contributed equally to this research and the writing of this article.

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search on the topic has relied on surveys of attitudes and behaviors and consequently has been scrutinized for not capturing the construct appropriately (Antonakis et al., 2016). Indeed, recent reviews of the charisma literature have encouraged scholars to adopt new theoretical and methodological approaches (Antonakis et al., 2016).

In line with these calls, we offer a new perspective, focusing on biological factors important for the formation of the strong bond that charismatic leaders form with their followers. Building on charismatic leadership theory and attachment theory (Bowlby, 2008), we contend that the neuropeptide oxytocin (OT), implicated in parent–infant attachment, plays a similar role in the leader–follower relationship and thus may help explain the outstanding effects such leaders have on groups. Research on OT has demonstrated its role in enabling parent–infant bonding in animals and humans (Donaldson & Young, 2008; Rilling & Young, 2014). In particular, research in mammals found that OT stimulates maternal behavior, nurturing, partner preference, and mating (Donaldson & Young, 2008). Studies of intranasal OT administration in humans further demonstrated the involvement of OT in bond formation, as manifested in parent–child synchronized behavior (Strathearn, Fonagy, Amico, & Montague, 2009; Weisman, Zagoory-Sharon, & Feldman, 2012).

The intensity of the leader–follower relationship and its resemblance to parent–child bonds has stimulated research that associated leader attachment with both leaders' style and followers' attitudes, finding parallel behaviors to those identified in classic attachment studies (e.g., Adam, Gunnar, & Tanaka, 2004; Collins & Feeney, 2000). Just like caregivers with their offspring, charismatic leaders serve as attachment figures who provide followers with proximity, support, and encouragement (Popper & Mayseless, 2003). Overall, based on the research linking OT and attachment and the studies that portrayed charismatic leaders as attachment figures, we expect OT to facilitate the charismatic leader–follower relationship.

Consistent with accumulating evidence on the role of OT in social functioning, we argue that OT will facilitate the effects of charismatic leaders on followers. This is in line with the social salience hypothesis of OT (Shamay-Tsoory & Abu-Akel, 2016), according to which, OT modulates the impact of the most salient social aspect of a certain context. Specifically, OT interacts with several neurobiological systems (such as the reward dopaminergic circuitry and the hypothalamic-pituitary-adrenal stress axis) to increase motivation to attend to salient social cues (Bartz, Zaki, Bolger, & Ochsner, 2011; Gordon et al., 2013; Shamay-Tsoory & Abu-Akel, 2016). Given the socially salient nature of charismatic leaders (Hogg, 2001), we expect OT to boost the effects of such leaders on group members.

Another important aim of this work is to demonstrate that the effects of OT go beyond the individual and dyad levels of analysis to explain interpersonal interactions, including contagion processes in groups. Previous work found that OT positively affected ingroup cohesion, cooperation, and trust among individuals (De Dreu et al., 2010; Kosfeld, Heinrichs, Zak, Fischbacher, & Fehr, 2005; Shalvi & De Dreu, 2014). Nevertheless, rather than testing actual interactions among group members, these studies included a single individual in imagined contexts. For instance, De Dreu et al. (2010) studied trust among individuals in an imagined group context, where subjects under OT versus placebo engaged in a prisoner's dilemma game. They relied on imagined context despite research showing that the role of OT in trust building, as in the formation of attachment bonds, is through interpersonal interactions (Rilling & Young, 2014). Furthermore, interpersonal interactions, like behavioral synchrony and displays of affect, also play a central role in defining the group (Barsade, 2002). Thus, this study also indirectly contributes to understanding the effects of charismatic leaders on group contagion. We examine the actual contagion process among leaders and group members, unlike previous work (e.g., Erez et al., 2008), which only proposed contagion as a mechanism of a leader's influence on followers' positive affect.

We chose to focus on group members' behaviors and attitudes previously associated with both OT and leader charisma. Among the classic outcomes of charismatic signaling are followers' displays of positive affect, mimicry of leader behaviors, and engendered trust among group members (Berson, Da'as, & Waldman, 2015; Bono & Ilies, 2006; Cherulnik, Donley, Wiewel, & Miller, 2001; Erez et al., 2008; Niedenthal & Brauer, 2012). Indeed, past research has demonstrated that through mimicry, we understand others' mental states and share their experiences (Gallese & Goldman, 1998). Mimicry has been associated with mirror neuron activity, shown to be modulated by OT (Iacoboni, 2009; Perry et al., 2010). Similarly, OT has been associated with positive affect, positive communication in interacting partners (Gordon, Zagoory-Sharon, Leckman, & Feldman, 2010), and increased trust through its suppressive effects on amygdala activity (Baumgartner, Heinrichs, Vonlanthen, Fischbacher, & Fehr, 2008).

In line with the social saliency model of OT and the above findings linking charisma and OT to trust, we argue that the combined effects of charismatic signaling and OT will go beyond facilitating leader effects on followers to influence the latter's attitudes toward each other. This can occur directly or indirectly through the relationship that followers form with the leader.

In summary, we expect that OT will enhance the relationship between a charismatic leader's signaling—consisting of verbal, nonverbal expressions, and perceptions of the leader's charisma—and followers' outcomes (see Figure 1). Specifically, we expect OT to moderate the effects of verbal and nonverbal signaling on two key relational outcomes, namely, group members' displays of positive affect through facial expressions and vocalizations (Hypothesis 1) and group members' mimicry of the leader's gestures (Hypothesis 2). In addition, we theorized that the moderating effects of OT on these relational outcomes of charisma will facilitate trust among group members (Hypothesis 3). Similarly, we expected OT to moderate the relationship between group members' perceptions of the leader's charismatic signaling and members' willingness to trust each other, such that under OT, perceived charisma would predict higher levels of trust within the group than under placebo (Hypothesis 4). We summarize the above hypotheses in a model.

Method

Participants

To examine our hypotheses, we conducted a controlled, double-blind single intranasal administration study (Guastella, Mitchell, & Dadds, 2008). Participants were 87 men (age, $M = 24.89$ years, $SD = 3.67$, range = 19–36 years), recruited through campus-wide

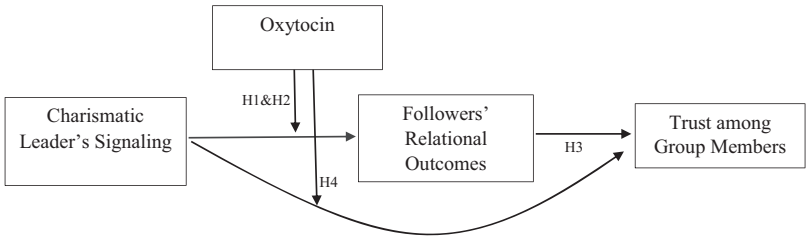

Figure 1. Guiding model. Charismatic leader's signaling refers to verbal and nonverbal behaviors (H1, H2, and H3) as well to perceived charisma (H4).

advertising and an online recruiting system and offered $30 for their participation. Participants were randomly assigned to 29 three-member groups, either experimental ($k = 15$ groups, $n = 45$ participants) or placebo ($k = 14$ groups, $n = 42$ participants). For behavioral microanalyses (see below), we used data from 28 groups ($n = 84$) due to low quality of the videotaped recording in one group. Sample size was determined based on power analysis (to allow for a medium effect size).

In addition to three participants, each group also included a confederate, whom we trained to specifically display charismatic leadership using several procedures. First, we followed both classic work on charisma (e.g., House, 1977; Weber, 1947) and accumulating evidence that it can be taught (Frese, Beimel, & Schoenborn, 2003; Towler, 2003) to adapt charismatic leadership tactics (CLTs), developed in previous research (Antonakis, Fenley, & Liechti, 2011) to the context of the group task. These tactics emphasize symbolic use of power and emotions that is unique to charismatic influence (Antonakis et al., 2011). Second, in addition to the theoretical anchoring of our approach, we trained the confederates to follow a protocol consisting of specific statements reflecting those CLTs, to be used verbatim, as well as instructed them to use typical nonverbal signaling that reflects charismatic leadership (Awamleh & Gardner, 1999). Table 1 includes examples of the CLTs and associated statements. Finally, to further ensure that confederates follow the specific protocol, we conducted pilot runs followed by feedback based on survey assessments and interviews of participants (see online supplemental material for detailed training procedures). The institutional review board of the Department of Psychology at Bar-Ilan University approved this research.

Procedure

Following informed consent, participants received either OT or placebo (see details of this procedure and validation of the OT manipulation in the online supplemental material). Forty-five minutes after administration, the interval needed for OT to take effect (MacDonald et al., 2011), the experimenter asked for volunteers to lead the group in a task but always chose the confederate. This "volunteering" act helped establish the role of the confederate as a leader, a role that was further instituted when the experimenter asked the confederate to present the task and to provide instructions to group members, and emphasized the confederate's responsibility for the success of the group (see details in the online supplemental material). We introduced the desert survival task (DST), in which participants are asked to rank order items (e.g., map, water), individually and as a group, based on their relevance to survival in a desert, a task widely used in previous research to examine leadership in groups (Lafferty & Pond, 1974). After completing the task, participants rated trust within the team and their perceptions of the charismatic leadership of the confederate.

Study design. Given the nested structure of our study, we tested all our hypotheses using a multilevel design. For the first two hypotheses, we tested the effects of OT versus placebo on differences in participants' behaviors when the confederate used or

Table 1
Sample Confederates' Verbal and Nonverbal Behaviors

Verbal signaling	Sample statement
Optimistic framing and goal articulation	"Guys, let's think about our strategy . . . ." "We should focus on items that help us to get help . . . ." "We are a great team—let's begin by hearing where you guys stand on these items."
Use of stories to symbolically communicate confidence in the team	"Based on my experience in a drill as part of my service in a prestigious combat unit of the military, we were stuck in a place, were confused . . . but found our way out . . . ." "We all survived the military, have the right experience, so we can do it."
Sharing the sentiment of the collective	"Guys, I know it's confusing but we're in the right direction."
Setting high expectations (inspirational messages)	"We are in the right direction . . .," "we are on the path to getting the reward"
Exuding confidence	"We are successful," "you guys are the best"
Use of humor	"It seems confusing because we are on drugs, aren't we?"
Use of rhetoric questions	"Anybody see himself walking 70 km in the desert?"
Nonverbal signaling	Behaviors
	Instructed confederates to use body gestures and facial expressions typical to charismatic leadership (showed a picture from Antonakis et al., 2011, p. 388), as well as rely on animated voice tone

Note. Sample statements and nonverbal behaviors, representing different charismatic leadership tactics, from the protocol used by the confederates.

did not use charismatic signaling (within-group effect). This was assessed via the behavioral microanalysis of the videotaped interaction among group members, including the confederate, while the group had been engaged in the task. To test the third hypothesis, we examined the relationship between both positive affect and mimicry index and a survey measure of trust within the team. For the fourth hypothesis, we examined the interactive effects of OT on the relationship between perceived charisma and trust (measured by surveys).

Measures. We measured charismatic leadership with 11 items from the Conger and Kanungo (Conger, Kanungo, & Menon, 2000) scale of charismatic leadership (see online supplemental Appendix S1; Cronbach's alpha = .87). These items reflect charismatic behaviors that were undertaken by the leader. We measured trust in the group with nine items that represent an adaptation of the McAllister scale (McAllister, 1995), reflecting both cognitive and affective aspects of trust (see online supplemental Appendix S2; Cronbach's alpha = .93).

Microanalysis of behavior. All interpersonal interactions were videotaped in a way that captured group members as they underwent the DST. We used Noldus, a computerized coding software, to extract participants' behaviors as conditional probabilities (i.e., behaviors of participants that co-occur with the behavior of the confederate). Although, generally speaking, the effects of leaders on followers' behavior may last longer than seconds, we focused on behaviors that manifest automatic processes, namely, emotional contagion and behavioral mimicry (Hatfield, Cacioppo, & Rapson, 1993). As such, for both affect and mimicry outcomes, we computed the total duration in seconds of group members' behavior at times when the confederate used charismatic signaling and compared it with the same code for times when the confederate did not display such signaling. Coding was done by a trained graduate student who coded behaviors in line with previous research (Feldman, Weller, Zagoory-Sharon, & Levine, 2007). Finally, because the distribution of positive affect behaviors duration contained many zero scores, we transformed it with the $y = \log(x + 1)$ transformation (Edwards, 1950).

Statistical analysis. We tested all hypotheses using Mplus 7 (Muthén & Muthén, 2012; see online supplemental material for details) with a multilevel model, controlling for within-group variation in all our tests. To test Hypothesis 1 and Hypothesis 2, we also accounted for within-subject variation (behavior displayed by the same subject when the leader did or did not display behavior). Specifically, we examined whether OT accounted for differences in subjects' behaviors, that is, total duration in seconds of positive facial expressions and in positive vocalizations (Hypothesis 1) and in self-regulatory (SR) acts (Hypothesis 2), when the confederate displayed or did not display behavior. We then examined whether these behavioral indexes predicted trust among team members (Hypothesis 3). Finally (Hypothesis 4), we tested the interactive effects of OT (group level) on the relationship between perceived charisma and trust (individual level). In online supplemental Tables S1 and S2, we report estimates of all variables from our analyses.

Controls. To account for potential differences between the two confederates who participated in this study, their identity was entered as a control in all analyses. Participants' age was also entered as a control in these models to account for variation among subjects on this variable (range = 19–36).

Results

In support of Hypothesis 1, we found a significant interaction (see Figure 2) between OT and leader behavior, that is, expression of charismatic rhetoric, in predicting positive displays of emotions among group members {Y (interaction) = .26 (p = .027)}. We tested the significance of the slopes using simple slope analysis. As expected, only the OT slope was significant (slope = .29, t = 2.38, p = .03).

In support of the moderating role of OT on the relationships between leader behavior, that is, engagement in self-regulation behavior, and followers' mimicry of the leader (Hypothesis 2), we found a significant effect for the interaction {Y (interaction) = 63.05 (p = .01)}. As can be seen in Figure 3, the pattern of the interaction is consistent with our hypothesis. Under OT, leader gestures were mimicked more compared to placebo. A simple slope analysis indicated that only the OT slope was significant (slope = 71.2, t = 2.48, p = .02).

We found no support for Hypothesis 3, linking followers' displays of emotions and mimicry of leader self-regulation with their trust in each other. Specifically, the interactive effects of the charismatic leader's signaling and OT on trust among team members was not mediated by both followers' relational outcomes. Finally, in support of Hypothesis 4, we found that OT significantly facilitated the relationship between charisma perceptions and trust among team members {Y (interaction) = 2.12 (p = .001)}. Simple slope analyses indicated that both the OT {5.01, $t(87)$ = 3.41 ($p <$ .001)} and placebo {2.89, $t(87)$ = 3.85 ($p <$ .001)} slopes were significant (see Figure 4), yet high levels of charisma, under OT, predict more trust in the team.

Discussion

Charismatic leaders have brought the world both promise and peril. Weber (1947) described them as "endowed with supernatural, superhuman . . . qualities" (p. 358) and as having enthusiastic and devoted followers (Antonakis et al., 2016). At the core of charismatic influence is a unique emotional bond with followers. We argued here that biological factors modulate this universal

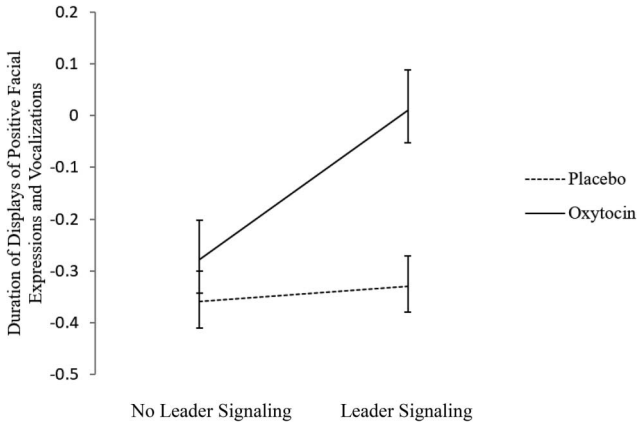

Figure 2. Oxytocin enhanced the effects of the charismatic leader's verbal signaling on a log(10) transformation (see above) of the total duration (in seconds) of displays of positive emotions. Error bars represent standard errors of the mean.

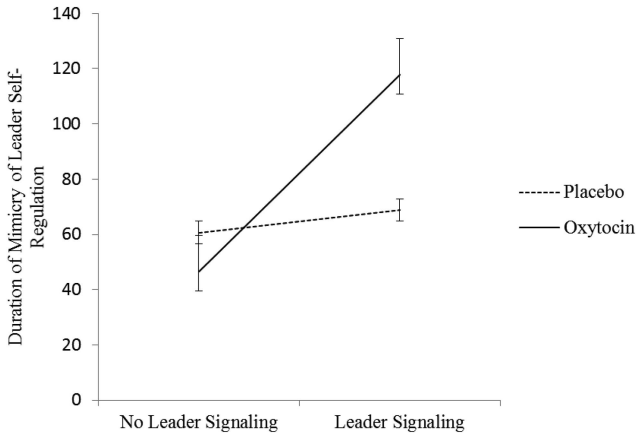

Figure 3. Oxytocin moderated the effects of the leader's nonverbal signaling on the total duration of time (in seconds) group members displayed self-regulation acts, mimicking the leader. Error bars represent standard errors of the mean.

bond. Overall, the results supported our hypotheses, demonstrating the role of the neuropeptide OT in facilitating charismatic influence. In line with previous research on attachment bonds, we found OT to be implicated in the interpersonal foundations of charismatic influence. Under OT, followers, exposed to leader influence, show positive displays of emotions and mimic their leaders more than under placebo. Consistent with the social saliency model of OT (Shamay-Tsoory & Abu-Akel, 2016), we found that OT enhanced the effects of the most salient stimulus in the group interaction—the leader's charismatic style.

Unexpectedly, we did not find a relationship between the relational outcomes of charismatic leadership and trust within the group, ruling out one potential path for the effects of charismatic leaders on members' trust in other group members. Other factors, not measured here, such as trust in the leader, may be explored in future studies. Nevertheless, consistent with extant research (Berson et al., 2015), we did find a direct relationship between group members' perceptions of the leader's charisma and trust among group members. In line with Hypothesis 4, OT significantly enhanced this relationship.

The above findings make three key contributions. First, by integrating theory and methodology from developmental psychobiology and social- and Industrial/Organizational Psychology they provide initial support for the role of biological factors in the charismatic relationship. Second, unlike most previous work (e.g., Erez et al., 2008) that relied on surveys, by utilizing behavioral microanalyses methodologies, we were able to examine real group interactions and to demonstrate the contagion effects that leaders have on followers. Finally, the above findings may attest to the fact that beyond the deep leader–follower bond, OT may play a role in how charismatic leaders shape member–member bonds. Future research may also extend the study of OT to investigate how emotions are propagated in groups to explain such phenomena as crowd behavior (Niedenthal & Brauer, 2012).

Alongside its contributions, this study suffers from several limitations. Most notably, whereas the manipulation of OT was carefully conducted, placebo controlled, and double blind, we did not systematically manipulate charismatic leadership. Consequently, we have had less control over the extent to which confederates' interventions were specifically charismatic in nature.

While not fully addressing this concern, we took several steps to alleviate it. First, we followed strict behavior microanalysis procedures to carefully record each confederate behavior (e.g., hand movement, voice). This approach, first introduced here to leadership research, allowed us to differentiate between instances in which confederates were active and those in which they were not. To ensure that when confederates were active, they acted charismatically, we extensively invested in training them to display both verbal and nonverbal theoretically anchored and experimentally validated CLTs and to *avoid* using other leadership styles (e.g., directing, being considerate). We further instructed them to follow a protocol including task-specific statements and gestures and conducted videotaped "dry" sessions. While watching the videos, we provided them with specific feedback about the extent to which each action they took was charismatic or reflected other styles. In one case, we dismissed a potential confederate who did not abide by the protocol. Finally, we were able to roughly replicate the interaction pattern we obtained with all key dimensions of charismatic signaling: verbal, nonverbal, and followers' attributions, assessed through a valid measure of the construct of charismatic leadership (Conger et al., 2000).

A related concern, common to within-subject designs, has to do with the extent to which periods of charisma behavior may have contaminated or lingered into periods in which the confederate did not intervene. Yet, the fact that participants and confederates were unfamiliar to each other may have reduced the chances that charisma will become routinized and increased the likelihood that there will be more charisma when it is exhibited than when it is not. Furthermore, if such contamination occurred, it would only weaken the interaction effect because it would water down the distinction between the two within-subject conditions.

To address these concerns, a future study could rely on a 2×2 between-factor design in which charisma is manipulated alongside with OT. While previous research has encountered challenges in manipulating charisma in the lab, there is evidence that this is possible (Howell & Frost, 1989; Jung & Avolio, 1999). In such a

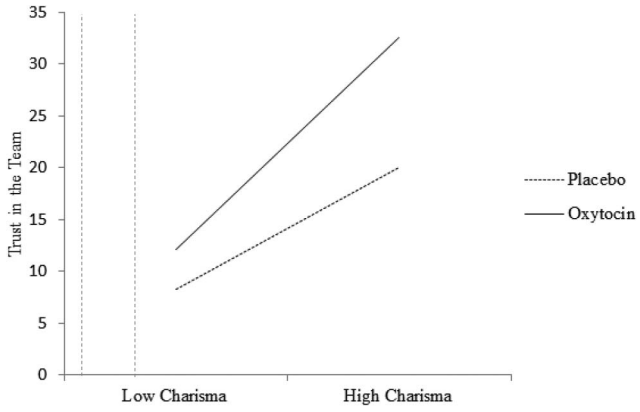

Figure 4. Oxytocin enhanced the relationship between perceptions of the leader's charisma and team members' trust in each other. Graph depicted at low and high points of perceived charisma. Blue dotted line represents confidence bands (outside the bands' differences between oxytocin and placebo are significant).

future study, confederates could be trained to behave charismatically and noncharismatically in OT versus placebo conditions.

Finally, we note concerns regarding the not yet fully understood mechanism by which OT is delivered to the brain following nasal administration (Leng & Ludwig, 2016). Notwithstanding such concerns, there is currently ample research, both in animals and humans, showing that intranasal OT can indeed reach the central nervous system to present in cerebral spinal fluid and exude central effects (e.g., Quintana & Woolley, 2016; Striepens et al., 2013).

In conclusion, despite being preliminary, our work provides a new, biological angle to a phenomenon that spurred interest among scholars across disciplines. Our findings address the role of OT in illuminating the path through which effective leaders facilitate emotional and behavioral contagion among group members.

Context of the Research

In a rather rare collaboration between a developmental neurobiologist (Gordon) and an organizational leadership scholar (Berson), we built on our backgrounds in OT research on mother–infant dyads and charismatic leadership in organizations. From the extensive research on charisma, we knew that scholars agree on the centrality of the profound bond between leaders and followers but know very little about the role of biological factors. The study of interpersonal interactions by developmental neuropsychologists provided both a theoretical (i.e., attachment theory) and empirical means (behavioral microanalysis) to tackle this unknown. We view this effort as a stepping stone for future collaborations. For example, we plan to examine the role of OT in emotional contagion in groups and to study physiological synchrony associated with justice violation and rivalry between groups. As we believe we have done with charismatic leadership, we hope that by bridging across disciplinary boundaries, we might be able to harness new theory and methods to address other social psychological questions that still wait for an answer.

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