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ORIGINAL PAPER

Oxytocin and the Biological Basis for Interpersonal and Political Trust

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Abstract Political scientists have documented the many ways in which trust influences attitudes and behaviors that are important for the legitimacy and stability of democratic political systems. They have also explored the social, economic, and political factors that tend to increase levels of trust in others, in political figures, and in government. Neuroeconomic studies have shown that the neuroactive hormone oxytocin, a peptide that plays a key role in social attachment and affiliation in non-human mammals, is associated with trust and reciprocity in humans (e.g., Kosfeld et al., Nature 435:673–676, 2005; Zak et al., Horm Beh 48:522–527, 2005). While oxytocin has been linked to indicators of interpersonal trust, we do not know if it extends to trust in government actors and institutions. In order to explore these

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relationships, we conducted an experiment in which subjects were randomly assigned to receive a placebo or 40 IU of oxytocin administered intranasally. We show that manipulating oxytocin increases individuals' interpersonal trust. It also has effects on trust in political figures and in government, though only for certain partisan groups and for those low in levels of interpersonal trust.

Keywords Trust · Government · Biology · Oxytocin

Trust pervades almost every aspect of our social lives. It determines how we make personal as well as social decisions. It is also important to the functioning of institutions that are at substantial remove from individuals. In the economic arena, high levels of interpersonal trust have been tied to strong economic performance (Zak and Knack 2001). The quality of democracy has also been shown to be positively correlated with high levels of trust (e.g., Brehm and Rahn 1997; Putnam 1995). In short, trust is important for a well functioning society.

For this reason, a great deal of scholarship has explored the causes of trust in others and of trust in government. To date, the focus of much of the existing literature has been on how one's social, political, and economic environment influences levels of trust. We know that declining incomes, lower involvement in civic organizations, greater income inequality, an increased crime rate, and lower educational attainment diminish interpersonal trust (Brehm and Rahn 1997; Knack and Zak 2003; Putnam 1995, 2000; Zak and Knack 2001). Turning to trust in government, lower levels of interpersonal trust, dissatisfaction with the economy, political figures, and the social fabric, as well as corruption, all contribute to lower levels of trust in government (e.g., Anderson and Tverdova 2003; Brehm and Rahn 1997; Chanley et al. 2000; Citrin 1974; Hetherington 1998).

While such factors have been shown to play an important role in trust levels, here we investigate the role that biology plays in the formation of trust and how it relates specifically to government actors and institutions. That is, is there an identifiable biological substrate that contributes to an individual's propensity to trust others, political actors and their government? Scholars are just beginning to explore the biological foundations of trust in a political context. In a recent piece, Sturgis et al. (2010) found that genes account for about a quarter of the variance in interpersonal trust. Here we explore a different biological factor, the neuroactive hormone oxytocin (OT), and we further probe the links between biology and trust by looking at interpersonal trust as well as trust in government actors and institutions.

OT has been positively associated with trusting strangers with money in laboratory studies, as well as other pro-social behaviors in humans (Zak 2008). When people are trusted their brains release OT, which motivates reciprocity (Morhenn et al. 2008; Zak et al. 2004, 2005). Studies that have directly manipulated OT levels in the human brain have shown that this causes people to exhibit greater trust in strangers with their money (Kosfeld et al. 2005; Zak 2008), generosity toward others in economic games (Zak et al. 2007), and the ability to infer emotional states of others (Domes et al. 2007).

Since OT has been shown to cause trusting and pro-social behaviors, we ask if OT affects general assessments of interpersonal trust, trust in political figures, as

well as trust in government. In other words, we are exploring if the biological basis for trust, which was formerly only tested in the context of the economic trust game, scales up to trust in others more generally, trust in political actors and in government institutions. We hypothesize that OT will have a positive effect on interpersonal trust, in line with previous work from economic games. We also explore whether this positive effect of OT extends to trust in political actors and institutions. Once we turn to look at government actors and institutions, we expect that the effects of OT may vary across different partisan groups. We test two hypotheses with respect to the moderating effects of partisanship. First, some research in political science suggests that individuals may evaluate members of their own team more positively; thus, Democrats on OT may have more favorable evaluations of Democrats and Republicans may have more favorable evaluations of Republicans. Second, recent research in neuro-politics suggests that Democrats may be more affected by OT than Republicans. Finally, across all cases we consider whether the effects of OT are moderated by initial levels of interpersonal trust, with the expectation that the effects will be more pronounced among those with low levels of interpersonal trust. To examine these relationships, we ran an experiment in which participants were randomly assigned to a condition that manipulated OT levels or to a placebo condition, and compare survey responses between the two conditions.

Causes and Consequences of Trust

It is widely accepted by scholars that trust has a range of positive effects for democratic systems of government.[1] Trusting individuals have higher levels of social solidarity and cohesion as well as higher levels of efficacy toward and confidence in government (e.g., Almond and Verba 1963; Booth and Richard 1998; Brehm and Rahn 1997; Chanley et al. 2000). Trust has also been shown to increase democratic values (Booth and Richard 1998), constrain immoral behavior (Rotter 1980), and has been linked, directly or indirectly, to increased citizen participation in the political system (e.g., Brehm and Rahn 1997; Citrin 1974; Levi and Sherman 1997; Tavits 2006; Weingast 1997). Studies also show that trust in political figures and government has many positive consequences. Citizens with high levels of trust in government are more likely to comply with government demands such as tax paying (Scholz and Lubell 1998), are more supportive of government spending (Chanley et al. 2000; Hetherington 2004; Hetherington and Globetti 2002; Rudolph and Evans 2005), and have higher evaluations of the president and Congress (Hetherington 1998).

Turning to the causes of interpersonal trust, scholars have primarily focused on the effects of environmental factors at the individual and aggregate levels. Some argue that interpersonal trust develops primarily through early childhood socialization (e.g., Uslaner 2002), while others give primacy to one's involvement in civic associations (Putnam 1993, 1995, 2000, also see Booth and Richard 1998). Other individual level factors that have been correlated with interpersonal trust are one's

[1] However, Muller and Seligson (1994) find that interpersonal trust is an effect rather than a cause of democracy.

values, life satisfaction, and personal optimism (Brehm and Rahn 1997; Rahn and Transue 1998; Uslaner 1998), as well as confidence in government (Brehm and Rahn 1997). Finally, demographic and socioeconomic factors play a role in trust, with those higher in socioeconomic status being more trusting, and African Americans being less trusting (e.g., Brehm and Rahn 1997). At the aggregate level, high income inequality, societies with high levels of corruption and crime rates, and younger generations have lower levels of interpersonal trust (Brehm and Rahn 1997; Knack and Zak 2003; Zak and Knack 2001).

Scholars have also uncovered many reasons for trust in government, which has been on the decline since the 1960's. Higher levels of interpersonal trust (Brehm and Rahn 1997; Putnam 1993, 1995, 2000), perceptions of policy congruence (Citrin 1974; Miller 1974), procedural fairness and justice (Craig 1993; Dennis and Owen 2001; Tyler 1994), as well as being a government employee (Corey and Garand 2002), are associated with higher levels of trust in government. Meanwhile, countries plagued by corruption exhibit lower levels of trust in civil servants (Anderson and Tverdova 2003). In looking at declines in trust in government over time, scholars have found that the decline is associated with dissatisfaction with the economy and rising crime rates (e.g., Citrin and Green 1986; Chanley et al. 2000; Hetherington 1998), with citizens' disaffection with policy alternatives (Miller 1974) and incumbent political leaders (e.g., Citrin 1974; Citrin et al. 1975; Orren 1997), and with increasing party polarization (Craig 1996; King 1997). Finally, trust in government is lower among African Americans and Latinos compared to whites (e.g., Avery 2009; Schildkraut 2005).

While the causes of interpersonal and governmental trust outlined above are an important part of the story, it is also possible that variation in trust across individuals is even more basic and more fluid than it is typically presented in political behavior research. The literature is just beginning to explore the relationship of biology to trust (Kosfeld et al. 2005; McCabe et al. 2001; Zak et al. 2005), and the results have been promising. Zak and colleagues have discovered that the neuroactive hormone OT affects, and is affected by, trusting behaviors between strangers (Kosfeld et al. 2005; Zak et al. 2005). In an analysis of twins, Sturgis et al. (2010) find that twenty-five percent of the variance in interpersonal trust can be explained by genetic factors. However, existing work has not explored the links between biology and trust in government actors and institutions. Our interest in this article is to determine how OT affects interpersonal trust, trust in political actors, and trust in government institutions. One important characteristic of OT is that the release of it is not constant in individuals. Thus, different elements in the environment may increase or diminish its release, which may in turn affect the dependent variables we are interested in.

Oxytocin, Interpersonal Trust, and Trust in Government

Trust and pro-social behaviors are important to living in any society. Humans have been conditioned to engage in positive social behaviors for mutual benefit. The biological basis underlying trust in others has only recently begun to be understood. One factor that was recently discovered that facilitates trust in strangers is OT (Zak et al. 2005; Zak et al. 2007). OT is synthesized in the brain and released both in the

brain itself and to target organs outside the central nervous system. OT has a three to five minute half-life and can be thought of as an on–off regulator that modulates approach/withdrawal behavior. The body does not produce OT without a stimulus and therefore basal OT levels are near zero. When a safe situation involving another person is sensed, OT is released and motivates approach and reciprocity. OT has traditionally been known to be released during childbirth, breastfeeding and sex.

In the last several years, non-reproductive stimuli have been discovered that cause OT to be released as measured through blood draws. Studies show that OT is higher after individuals receive an intentional transfer of money from another person denoting trust (Zak et al. 2004, 2005), and after viewing a highly emotional video (Barraza and Zak 2009). OT levels in the brain and blood correlate, so stimulating OT release and measuring it in blood provides evidence for a change in the brain levels of OT (Zak 2008).

In OT manipulation studies, typically a nasal inhaler of synthetic OT is used to infuse OT into the brain. There is evidence that small peptides like OT cross the blood–brain barrier (Born et al. 2002) and affect behavior (Zak 2008). The pharmacokinetics that Born et al. identify suggests a roughly one hour period before OT infusion has substantial effects on levels in cerebral spinal fluid, with elevated OT lasting for approximately three hours when behavioral studies can be performed. OT infusion studies are designed to demonstrate the causal effect of OT on behavior, complementing findings from studies that measure endogenous OT release in blood samples.

Several studies in neuroeconomics reveal increased trusting behaviors for subjects infused with OT relative to subjects given a placebo. Kosfeld et al. (2005) find that infusing 24 IU of oxytocin into the human brain causes a 17 % increase in monetary transfers denoting trust in the economic trust game, and more then doubles the number of people who show maximal trust by sending all of their money to the other person in the dyad.[2] In another economic decision task between strangers, called the Ultimatum Game,[3] infusing participants with 40 IU of oxytocin causes offers to be 80 % more generous (Zak et al. 2007). Outside of economic games, OT infusion has been linked to a 3 % increased ability to infer emotional states of others from photographs (Domes et al. 2007), possibly due to increasing visual attention to others' eye regions (Guastella et al. 2008). The brain's release of oxytocin is also associated with the subjective experience of empathy, even between strangers, and can thus be considered a foundation for pro-social behaviors (Barraza and Zak 2009).

With clear evidence linking OT to trusting and pro-social behaviors in others, we expect to find a positive relationship between OT and attitudinal expressions of interpersonal trust. Some studies of OT find that the effects on behavior are moderated by other factors (e.g., Heinrichs et al. 2003). One important factor to consider is one's

[2] There are two players in the trust game: decision-maker 1 (DM1) and decision-maker 2 (DM2). Both are endowed with equal amounts of money. After instruction, DM1 is prompted to take an integer amount of his monetary stake, including zero, and transfer it to DM2. The selected transfer is removed from DM1 s account, and tripled in the account of DM2. DM2 is then informed of the transfer and the total in his account, and prompted to return any amount from zero to his account total back to the DM1 in his dyad. The sub-game perfect Nash equilibrium of this game is for DM2 to return nothing, and subsequently for DM1 to send nothing, though this rarely happens (Smith 1998; Zak et al. 2005).

[3] In this game, a proposer is endowed with $10 and a responder has nothing. The proposer is asked to make an offer of a split of the money to the responder; if the responder accepts the offer, the money is paid, but if the offer is rejected, both parties get nothing.

baseline level to exhibit pro-social propensities. For example, in a study of autistics, those with the most severe symptoms experience the biggest increase in social behaviors when administered OT (Andari et al. 2010). While we are not dealing with autistics, a similar logic may be applied to studying attitudinal expressions of interpersonal trust. The effect of OT may be moderated by one's initial starting level of interpersonal trust such that the strongest effects for OT come among those who start out with lower levels of interpersonal trust, since they have further to move. Meanwhile, those who come to the lab with high levels of interpersonal trust may face a ceiling effect.

Expectations are a bit less clear when we turn to the political sphere, since little work has been done in this domain. To date, scholars have primarily linked OT to social interactions and individuals do not usually directly interact with political figures and institutions. There may therefore be no link between OT and trust in political actors and certainly institutions, which are at further remove from social interactions. However, some recent studies find that OT is released when individuals are not directly engaging in social interaction, but watch a highly emotional video (Barraza and Zak 2009). Politics is certainly an arena that elicits strong emotions. For example, research shows that individuals harbor strong emotions toward political candidates and these emotions are consequential for political evaluations and decisions (e.g., Marcus et al. 2000; Ragsdale 1991). While trust in government is more abstract, research suggests that when individuals are asked about their trust in government, they think of the person who is the sitting president (Locke et al. 1999). We therefore may find that the positive effects of OT extend to political figures and institutions, though this relationship may be moderated by a few factors.

First, the effect of OT may vary depending on one's baseline levels of trust. As noted above, the effects of OT may be more pronounced among those who start off with lower levels of interpersonal trust, since they have further to move than those who start out with high levels of trust. One way to approach this would be to have a pre and post treatment measure of trust toward each political actor and institution we evaluate. However, given that our study was part of a larger study, we were not able to include all of our questions pre and post treatment. We therefore are only able to measure interpersonal trust pre-treatment, and we consider this to be a general indicator of trust. In that sense, being low on the measure might serve as a "symptom" to be less trusting toward others in general. We therefore explore whether the effects of OT on trust in political actors and government is more pronounced among those who start out with lower levels of interpersonal trust. While this measure is not perfect, there is research which shows that those with higher levels of interpersonal trust are more trusting of political actors and government (e.g. Brehm and Rahn 1997; Putnam 1993, 1995, 2000),[4] so a general propensity to trust others may condition the effects of OT infusion.

Second, one's partisanship may moderate the effects of OT on trust in specific political actors and in government. There are two potential ways in which partisanship may moderate the effects of OT. First, partisanship may serve as a perceptual filter (Bartels 2000; Campbell et al. 1960; Zaller 1992) such that OT only has positive

[4] However, some research (Levi and Sherman 1997; Weingast 1997) shows that the causal arrows work in the other direction. Since we conduct an experiment, the post-treatment measures cannot affect pre-treatment measures.

effects on trust for members of one's own group. For example, OT may have positive effects on Republicans' trust in Republican political leaders, but not on Democrat's trust in such leaders. With respect to trust in government, if individuals think of the sitting president (Locke et al. 1999), then OT may have stronger positive effects among people who share the partisanship of the sitting president. Second, it could be that there are differences in the propensity of different partisan groups to be affected by OT, especially as it applies to trust in political actors and government. Recent research in neuropolitics suggests that Democrats may be more affected by OT than Republicans. Liberals are more likely to respond to novel information, while Conservatives demonstrate a more consistent neurological response, according to a brain imaging study by Amodio et al. (2007). More specific to this study, Liberals are far more influenced by the eye gaze cues of others (Dodd et al. 2011), which is an important indicator for social interaction (Moore and Dunham 1995) and has been associated with judgments of trustworthiness (Bayliss and Tipper 2006). Because OT is associated with increasing visual attention to the eye region of others (Guastella et al. 2008), there is a biological link that supports the argument that those on the ideological left may be more affected by OT.[5] Research in neuropolitics has focused more on ideology than partisanship, but the high correlation between partisanship and ideology, particularly in the current political environment (e.g. Abramowitz et al. 1998; Cook and Gronke 2005), leads us to expect similar effects if we look at how the effects of OT are moderated by partisanship.[6]

To summarize, we hypothesize that OT will increase evaluations of interpersonal trust, though this may be moderated by one's initial interpersonal trust level. We also explore whether OT has positive effects on trust in political figures and trust in government, moderated by partisanship and interpersonal trust. More specifically, the positive effects of OT should be most pronounced among those who start out with lower levels of interpersonal trust. With respect to partisanship, we test whether the effects of OT are stronger when evaluating members of one's own "team" or whether the effects of OT are stronger among Democrats.

Materials and Methods

Participants

A total of 132 male college undergraduates participated in this study in the early fall of 2007 at a university in southern California.[7] At the time of our study, Democrats

[5] Furthermore, this type of relationship would also be supported by existing literature in political science. Democrats are more trusting and supportive of expanding government, while Republicans champion limited government (e.g., Cook and Gronke 2005; Corey and Garand 2002; Rudolph and Evans 2005). Given Democrats' greater propensity to trust an active government, they may be more affected by OT for these types of questions.

[6] Partisanship is also more relevant as a moderating factor given the dependent variables we are considering.

[7] Only males are in the subject pool because one possible risk factor of taking OT intranasally is a spontaneous abortion. In females, the effects of OT also vary over the menstrual cycle.

controlled Congress, while George W. Bush was President. Since we are doing a study of trust in government, we only included US citizens in our analyses. This reduced the sample size to 88. Because of the inherent risk in drug studies, sample sizes are kept moderate. Indeed, having 88 participants is larger than many other published studies that have infused oxytocin into humans (e.g. Domes et al. 2007; Heinrichs et al. 2003; Zak et al. 2007).

The average age of our sample is 20.5 years, with participants self-identifying as Asian (51 %), Caucasian (25 %), Latino (7 %), African American (3 %), and the remainder identifying as another race or ethnicity. With respect to party identification, 42 % of the sample identifies as Democrat, 23 % as Republican, and the remainder as Independent, a member of another party, or as having no party affiliation. The average subject is moderate-left in terms of ideological leanings and slightly trusting of others.[8] The characteristics of our sample diverge in many respects from the national U.S. population, in that our sample is younger and more diverse. Our sample is also more Democratic and left leaning than participants in the American National Election Study. However, California does have a more diverse population than the rest of the country (only 58 % white compared to 72 % in the U.S.) and is more Democratic. The characteristic on which our sample diverges the most is that we have a very high percentage of Asians, though the university where we were conducting the study has a high percentage of Asian students (38 %).[9] The external validity of our findings are certainly limited by the characteristics of our sample, especially with respect to gender, since we are only looking at males, and potentially by race and ethnicity, since there are differences in levels of interpersonal trust and trust in government across different racial and ethnic groups. As we noted earlier, studies show that African Americans and Latinos have lower levels of trust in government than whites (Avery 2009; Schildkraut 2005). However, existing research has not explored how trust levels among Asians compares to other racial and ethnic groups. We return to a discussion of issues of validity in our discussion and conclusion.

Procedure

All participants gave written informed consent and underwent a medical screening for health and drug-interaction exclusions. Two participants were dismissed for medical reasons. Participants were asked to refrain from consuming alcohol and illicit drugs for 24 hours prior to entering the lab. Those who were included in the experiment were randomly assigned the drug or placebo, with neither those administering, nor those participating, knowing which was being given. Participants intranasally received either a dose of 40 IU (4 ml) of OT or 4 ml of normal saline (placebo) in the double-blind design. We ran a series of statistical tests to ensure that

[8] Participants' identities were masked throughout by assigning them an alpha-numeric code. All data were collected by computer and there was no deception of any kind.

[9] Asians out-number whites (34 %) among undergraduates at the institution. The presence of Latinos is similar to the national population (15 %), while African Americans are under-represented (3 %). This racial and ethnic make-up is certainly not the norm in the U.S. and therefore may limit the extent to which the results travel to the U.S. population.

subjects were evenly balanced between the OT and placebo conditions across a host of measures including age, height, weight, income, ideological leanings, partisanship, pre-treatment trust, and race and ethnicity. We did not find any evidence of imbalance[10]; thus, random assignment worked as intended.

While waiting and after substance administration, participants completed demographic and personality questionnaires by computer. Following published pharmacokinetics (Born et al. 2002), OT was allowed to load for 60 min before subjects were asked to complete the remaining study tasks. Therefore, the demographic and personality questionnaires that subjects completed before substance administration and 60 min post administration are considered part of the pre-treatment survey. After the loading period, participants filled out a survey on political attitudes, which included questions related to interpersonal trust, trust in government actors, and trust in government institutions.

Results

In this section, we first test the expectation that OT will increase interpersonal trust. We then look at whether OT is linked to trust in specific political actors and trust in government. In both cases we explore whether the effects are moderated by pre-treatment trust and in the latter case, we look at whether the effects vary across different partisan groups.

Trust in People

Our first task is to explore whether OT influences attitudinal measures of interpersonal trust. To measure interpersonal trust, subjects were asked to indicate whether they agreed with the statement that most people can be trusted (Brehm and Rahn 1997). The measure is coded on a three-point scale with higher values indicating more agreement.[11] We also include the interpersonal trust measure on the pre-treatment survey. In order to test the effects of OT, while mindful of *ex ante* trust levels, we model the effect of OT on interpersonal trust controlling for pre-treatment interpersonal trust in one model. We also run a model in which we interact the two measures to see if the effect of OT on post-treatment interpersonal trust is moderated by pre-treatment trust (and expect a negative sign on the interaction term since the effect of OT should weaken for those higher on pre-treatment interpersonal trust). The results of the ordered probit analyses are presented in Table 1. Turning to

[10] The p-values associated with the relevant test between the placebo and OT condition for each measure are as follows: age ($p = 0.54$); height ($p = 0.40$); weight ($p = 0.46$); income ($p = 0.94$); ideology ($p = 0.29$); Democrat ($p = 0.45$); Republican ($p = 0.73$); pre-treatment trust ($p = 0.97$); and, race and ethnicity ($p = 0.61$).

[11] This is similar to the question typically used on the National Election Study. Instead of choosing between the response options of "most people can be trusted" or "you can't be too careful in dealing with people," subjects indicated their level of agreement with the statement that most people can be trusted. Please see supplementary Table A in the supplemental document for summary statistics on all of our variables.

Table 1 Ordered probit on interpersonal trust levels

Variable	Model 1 Coefficient (SE)	Model 2 Coefficient (SE)
Oxytocin	0.495^{++} (0.279)	0.810 (0.953)
Pre-treatment trust	1.08^{++} (0.195)	1.151^{++} (0.287)
Oxytocin * pre-treatment trust	–	−0.134 (0.386)
Cut 1	2.325 (0.512)	2.499 (0.730)
Cut 2	3.074 (0.543)	3.249 (0.751)
N	83	83
R^2 (pseudo)	0.207	0.207

Standard errors in parentheses

$^{++}$ $p \leq .05$ (one-tailed); $^{+}$ $p \leq .10$ (one-tailed)

the first model, we observe a statistically significant positive effect of OT on interpersonal trust ($p = 0.038$, one-tailed).[12] Also as expected, pre-treatment trust has a positive and significant effect on post-treatment trust. Since ordered probit coefficients are not directly interpretable, we calculate the change in the probability of falling into the three categories of trust using CLARIFY (Tomz et al. 2001). Moving from the placebo to the OT condition decreases the probability of falling into the lowest trust level by 11.5 percentage points, increases the probability of falling into the middle trust level by 6.9 percentage points, and increases the probability of falling into the highest trust level by 4.6 percentage points. Overall, these are substantial effects on reported interpersonal trust among those who receive a dose of OT. This impact on generalized trust is a new finding as previous OT infusion studies have only shown an effect on person-to-person interactions. Looking at the second model, we do not find that these effects are moderated by the level of interpersonal trust that one entered the lab with.

Trust in Political Actors

We now turn to evaluate whether OT affects trust in political figures, and whether these effects are moderated by pre-treatment trust and partisanship. In the post-treatment survey, we asked individuals to rate their level of trust in a range of political figures on a five-point scale, with higher values indicating higher levels of trust. We asked about the incumbent president, George W. Bush, as well as some of the candidates in the Democratic and Republican primaries who were prominent in the fall of 2007. On the Democratic side, we asked about Hillary Clinton, Barack

[12] We use a one-tailed test since we expect a positive effect of OT on interpersonal trust. However, the effect is also significant using a two-tailed test, though only at $p < 0.10$. We also find similar effects if we just run a difference in means test on interpersonal trust between the OT and placebo, though the effects are outside of standard significance levels ($p = 0.11$, one-tailed). Even though it was not part of our expectations for interpersonal trust, we explored whether partisanship moderated the effects of OT and did not find this to be the case.

Obama, and John Edwards, while on the Republican side we asked about John McCain, Rudy Giuliani, and Mitt Romney.

We look at the effects for the whole sample and broken down by partisan group. Recall, there are two possible patterns we might observe. First, it could be that partisan groups only react favorably to OT when it is a political figure from their own party. In this case, we would expect OT to have a positive and significant effect on evaluations of the Democratic candidates among Democrats and on George W. Bush and the Republican candidates among Republicans. Second, Democrats could in general be more affected by OT than Republicans. We do not have clear expectations for Independents besides a possible positive effect of OT on trust. We should note that breaking up the sample by partisan group does reduce our n per cell substantially.[13]

We again run a model controlling for pre-treatment interpersonal trust and one interacting the drug with pre-treatment interpersonal trust. The latter model captures our expectation that the effects of OT will be most pronounced among those entering the lab with lower levels of general trust.[14] In the interest of space, we only display the results of the ordered probit analyses for the second model. Since the effects of OT are not directly interpretable from the interaction term, we calculate the coefficient and standard error of the OT measure at each level of pre-treatment interpersonal trust at the bottom of the tables. Results for the first model are discussed in footnotes if we find any significant direct effects of OT on trust and are available in Supplementary, Tables B1, B2, and B3. Given our directional expectations for OT (positive) and its interaction with interpersonal trust (negative), as well as the small sample size, we report one-tailed tests.[15]

We first look at trust in the incumbent President George W. Bush in Table 2. We do not find any significant effect of OT on trust in Bush for the whole sample. Among Democrats, we find support for a moderating relationship with pre-treatment trust levels, in that OT only appears to boost trust in Bush for Democrats at the lowest and middle level of pre-treatment interpersonal trust. However, both of these treatment effects are marginally significant to just outside of conventional significance levels ($p = 0.057$ and $p = 0.064$, one-tailed, respectively). The coefficients from the ordered probit analysis are not directly interpretable, so we again generated the substantive effects using CLARIFY. Moving from the placebo to the OT treatment decreases the probability of falling into the lowest category of trust in Bush by 43.3 percentage points and increases the probability of falling into the highest category of trust in Bush by 6.7 percentage points among those who came to the lab at the lowest level of interpersonal trust. The comparable effects for those at the middle level of pre-treatment trust are more modest, as expected, with a drop of 25.9 percentage points for the lowest category of trust and a 3.6 percentage point increase for the highest category of trust. We do not find any effects of OT on Republicans. Finally, we find that OT has a

[13] We are left with 19 Democrats on placebo and 17/18 on OT, 10 Republicans on placebo and on OT, and 12 Independents on placebo and 18/19 Independents on OT.

[14] As we noted earlier, it would also have been good to have pre-treatment measures for all of our dependent variables but we were unable to do this due to limited space on the survey.

[15] In the few instances where we find a sign opposite of expectations, we use a two-tailed test.

Table 2 Ordered probit on trust in George W. Bush

Variable	Whole sample coefficient (SE)	Democrats coefficient (SE)	Republicans coefficient (SE)	Independents coefficient (SE)
Oxytocin	0.838 (0.717)	2.081^{++} (1.392)	0.449 (1.786)	1.959^{++} (1.159)
Pre-Treatment Trust	0.316^{++} (0.208)	0.548^{++} (0.422)	0.335 (0.447)	0.928^{++} (0.428)
Oxytocin * pre-treatment Trust	-0.423^{++} (0.297)	−0.693 (0.553)	−0.411 (0.692)	-1.370^{++} (0.555)
Cut 1	0.223 (0.510)	1.524 (1.126)	−0.320 (1.160)	0.794 (0.812)
Cut 2	0.829 (0.513)	2.298 (1.148)	0.018 (1.150)	1.400 (0.824)
Cut 3	1.356 (0.521)	3.052 (1.187)	1.585 (1.200)	2.331 (0.877)
Cut 4	2.368 (0.566)	3.602 (1.233)		
N	86	37	19	30
R^2 (pseudo)	0.011	0.032	0.039	0.112
Coefficient of treatment				
Oxytocin for low trust	0.415 (0.446)	1.388^{+} (0.876)	0.038 (1.141)	0.589 (0.681)
Oxytocin for medium trust	−0.007 (0.247)	0.695^{+} (0.456)	−0.373 (0.610)	−0.781* (0.449)
Oxytocin for high trust	−0.430 (0.315)	0.001 (0.509)	−0.784 (0.633)	−2.150** (0.744)

Bush for the whole sample and by partisan group

Standard errors in parentheses

$^{++}$ $p \leq .05$ (one-tailed); $^{+}$ $p \leq .10$ (one-tailed); ** $p \leq .05$ (two-tailed); * $p \leq .10$ (two-tailed)

negative effect on trust in Bush among Independents who are at the middle and highest level of pre-treatment trust. This finding is unexpected and we do not have a clear justification for why this would be the case. Overall, the results for trust in George W. Bush are more supportive of the argument that Democrats may be more affected by OT than Republicans, since OT is boosting their evaluations of a Republican political figure, not a member of their own "team."

In Table 3, we run the analyses for the three Democratic candidates. We see that the effects of OT on trust in Clinton are moderated by interpersonal trust for the whole sample. Those infused with OT have higher trust in Clinton than those on the placebo for those at the lowest and mid level of pre-treatment interpersonal trust ($p = 0.017$ and $p = 0.06$, one-tailed, respectively). If we look at these results broken down by partisanship, it appears that Democrats are primarily driving these effects. OT increases the probability of falling into the most trusting category by 5.4 percentage points for Democrats at the lowest pre-treatment trust level ($p = 0.005$, one-tailed) and by 4.6 percentage points for those at the middle pre-treatment trust level ($p = 0.005$, one-tailed).[16] We do not find any effects of OT on trust in Hillary Clinton for Republicans or Independents at any level of interpersonal trust.

[16] In a model without the interaction term, OT increases trust in Clinton among Democrats.

Table 3 Ordered probit on trust in democratic political figures by partisan group

Variable	Whole sample coefficient (SE)	Democrats coefficient (SE)	Republicans coefficient (SE)	Independents coefficient (SE)
Hillary Clinton				
Oxytocin	1.474^{++} (0.703)	2.984^{++} (1.243)	1.082 (1.691)	−0.382 (1.130)
Pre-treatment trust	0.696^{++} (0.206)	1.021^{++} (0.367)	0.516 (0.452)	0.479 (0.390)
Oxytocin * pre-treatment trust	−0.549^{++} (0.290)	−0.938^{++} (0.501)	−0.669 (0.667)	0.417 (0.522)
Cut 1	−0.098 (0.507)	1.112 (0.887)	−0.354 (1.145)	−0.396 (0.798)
Cut 2	0.897 (0.489)	2.434 (0.976)	0.564 (1.117)	0.841 (0.792)
Cut 3	1.577 (0.505)	3.415 (1.020)	0.711 (1.122)	1.648 (0.821)
Cut 4	2.695 (0.541)	4.980 (1.104)	2.361 (1.258)	3.279 (0.931)
Cut 5	4.122 (0.655)			
N	86	37	19	30
R^2 (pseudo)	0.049	0.105	0.048	0.124
Coefficient of treatment				
Oxytocin for low trust	0.925^{++} (0.436)	2.046^{++} (0.782)	0.413 (1.076)	0.035 (0.677)
Oxytocin for medium trust	0.376^{+} (0.242)	1.108^{++} (0.423)	−0.256 (0.586)	0.452 (0.429)
Oxytocin for high trust	−0.173 (0.309)	0.170 (0.498)	−0.925 (0.648)	0.870 (0.675)
John Edwards				
Oxytocin	1.101^{+} (0.702)	2.050^{++} (1.186)	−0.455 (1.699)	0.062 (1.123)
Pre-treatment trust	0.489^{++} (0.204)	0.719^{++} (0.349)	0.779^{++} (0.458)	−0.240 (0.380)
Oxytocin * pre-treatment trust	−0.552^{++} (0.292)	−0.906^{++} (0.492)	−0.312 (0.665)	0.246 (0.509)
Cut 1	−1.305 (0.588)	0.387 (0.887)	0.398 (1.106)	−2.030 (0.876)
Cut 2	0.010 (0.492)	1.068 (0.888)	1.123 (1.111)	−1.089 (0.786)
Cut 3	0.699 (0.493)	2.570 (0.946)	2.351 (1.234)	−0.248 (0.774)
Cut 4	1.956 (0.520)	3.439 (1.000)		1.008 (0.787)
Cut 5	3.105 (0.597)			0.799 (0.652)
N	85	37	19	29
R^2 (pseudo)	0.026	0.048	0.149	0.024
Coefficient of treatment				
Oxytocin for low trust	0.550 (0.437)	1.143^{+} (0.734)	−0.767 (1.091)	0.308 (0.682)
Oxytocin for medium trust	−0.002 (0.243)	0.237 (0.392)	−1.079* (0.614)	0.554 (0.423)
Oxytocin for high trust	−0.553* (0.314)	−0.669 (0.505)	−1.391** (0.669)	0.799 (0.653)
Barack Obama				
Oxytocin	1.157^{+} (0.709)	0.690 (1.143)	−0.005 (1.748)	1.804^{+} (1.210)
Pre-treatment trust	0.587^{++} (0.208)	0.555^{++} (0.336)	0.770^{+} (0.470)	0.712^{++} (0.418)
Oxytocin * pre-treatment trust	−0.521^{++} (0.294)	−0.204 (0.475)	−0.139 (0.682)	−0.810^{+} (0.541)

Table 3 continued

Variable	Whole sample coefficient (SE)	Democrats coefficient (SE)	Republicans coefficient (SE)	Independents coefficient (SE)
Cut 1	−1.070 (0.584)	−0.676 (0.893)	−0.191 (1.185)	0.926 (0.866)
Cut 2	−0.797 (0.532)	−0.106 (0.850)	0.989 (1.148)	1.950 (0.903)
Cut 3	0.416 (0.496)	1.163 (0.882)	2.654 (1.274)	3.053 (0.950)
Cut 4	1.555 (0.522)	2.559 (0.913)		
Cut 5	2.779 (0.548)			
N	86	37	19	30
R^2 (pseudo)	0.035	0.04	0.099	0.044
Coefficient of treatment				
Oxytocin for low trust	0.636^{+} (0.441)	0.485 (0.710)	−0.144 (1.114)	0.994^{+} (0.731)
Oxytocin for medium trust	0.115 (0.245)	0.281 (0.392)	−0.283 (0.599)	0.183 (0.436)
Oxytocin for high trust	−0.406 (0.314)	0.077 (0.504)	−0.422 (0.639)	−0.627 (0.658)

Standard errors in parentheses

$^{++}$ $p \leq .05$ (one-tailed); $^{+}$ $p \leq .10$ (one-tailed); ** $p \leq .05$ (two-tailed); * $p \leq .10$ (two-tailed)

Turning to Edwards, in the whole sample, we find that OT has a positive effect on trust in Edwards among those at the lowest level of interpersonal trust, though the effect is not quite statistically significant ($p = 0.104$, one-tailed). Meanwhile, OT has a negative effect on trust in Edwards among those at the highest level of interpersonal trust ($p = 0.078$, two-tailed), which is unexpected. Once we break the analysis down by partisanship, it is clear that Republicans are driving the negative effect. OT has a negative effect on trust in Edwards among Republicans at the middle ($p = 0.079$, two-tailed) and highest level of interpersonal trust ($p = 0.038$, two-tailed), shifting the probability of falling into the most trusting category by 17.7 percentage points in the former case and 30.2 percentage points in the latter case, compared to those on the placebo. We did not expect any negative effects for OT, so these results are puzzling even though we are looking at Republicans evaluating a Democrat. Among Democrats, we again find that the effects of OT are moderated by interpersonal trust, with OT boosting trust for those at the lowest level of interpersonal trust ($p = 0.06$, one-tailed).[17] The effect is such that exposure to OT increases the probability of falling into the most trusting category by 7.2 percentage points. We find no effects among Independents for Model 2, though there is a positive direct effect of OT on trust in Edwards in Model 1 (See supplementary Table B2).

At the time of our study, Barack Obama was still not a very well known political figure. We find a positive effect of OT on trust in Obama in the whole sample for those at the lowest level of pre-treatment trust ($p = 0.07$, one-tailed). These

[17] In the model without interaction terms, OT leads to a drop in trust toward Edwards among Republicans and an increase in trust among Independents.

individuals become 5.1 percentage points more likely to fall in the highest trust level relative to those on the placebo. We find a similar effect for OT among Independents at lowest level of interpersonal trust ($p = 0.087$, one-tailed). However, these effects are marginally significant to just outside of conventional significance levels depending on whether one accepts a statistical cut-off of $p < 0.10$ for one-tailed tests.

The pattern of findings for trust in Democratic political figures suggests that Democratic partisans are affected by OT in the hypothesized ways. In two out of the three cases (Clinton and Edwards), we find that OT boosts trust in political leaders among Democrats at lower levels of interpersonal trust, while in only one case (Edwards) are Republicans affected by OT and the effect is opposite of expectations. Among Independents, we find two cases of OT boosting trust in leaders (for Edwards and Obama). These findings do not enable us to distinguish clearly between whether partisans react more favorably to their own team or to whether Democrats in general are more responsive to OT since we would expect the same pattern of results according to both accounts.

We get more purchase on this question by looking at trust in the Republican candidates in Table 4. We again find effects for OT on trust, moderated by pre-treatment interpersonal trust, among Democrats, though these effects are marginal to just outside of conventional significance levels. OT increases trust in Giuliani among Democrats at the lowest level ($p = 0.064$, one-tailed) and the middle level of pre-treatment trust ($p = 0.069$, one-tailed). Democrats at the lowest level of pre-treatment trust are 16.9 percentage points more likely to fall into the highest trust level of Giuliani given infusion of OT compared to the placebo. The comparable effect for those at the middle level of pre-treatment trust is 11.7 percentage points. OT also increases trust in McCain among Democrats at the lowest ($p = 0.10$, one-tailed) and middle level ($p = 0.076$, one-tailed) of interpersonal trust, though the substantive effects are not as great as they are for Giuliani (leading to only a 1-2 percentage point increase in the probability of falling into the most trusting category; though there is a 19.1 and 3.7 percentage point drop in the probability of falling into the least trusting category). Finally, OT has a positive effect on trust in Romney among Democrats at the lowest level of interpersonal trust ($p = 0.068$, one-tailed), increasing the probability of falling into the most trusting category by 5.3 percentage points and decreasing the probability of falling into the least trusting category by 32.3 percentage points. OT does not have any effect on trust in the three candidates among Republicans or Independents.

Overall, we find that OT has positive effects on trust in many political figures, though many of the effects are marginally significant to just outside of conventional significance levels and are moderated by one's level of interpersonal trust as well as partisanship. Most of the suggestive effects of OT obtained among individuals who had came to the lab with lower levels of trust in others and identified with the Democratic Party. Rather than serving as a filter, these results suggest that Democrats may be more susceptible to OT than Republicans, especially those who have low to middle levels of trust in other individuals in society. While many of our findings are marginal to suggestive, the consistent results for Democrats low in interpersonal trust across political figures suggest a meaningful pattern. We had a

Table 4 Ordered probit on trust in republican political figures by partisan group

Variable	Whole sample coefficient (SE)	Democrats coefficient (SE)	Republicans coefficient (SE)	Independents coefficient (SE)
Rudolph Giuliani				
Oxytocin	0.923^{+} (0.702)	1.612^{+} (1.151)	0.149 (1.706)	1.203 (1.134)
Pre-treatment trust	0.304^{+} (0.198)	0.543^{++} (0.329)	(0.429)	0.195 (0.375)
Oxytocin * pre-treatment trust	−0.404^{+} (0.290)	−0.515 (0.472)	0.012 (0.665)	−0.756^{+} (0.515)
Cut 1	−0.709 (0.497)	0.031 (0.849)	−0.639 (1.142)	−1.113 (0.795)
Cut 2	0.007 (0.483)	0.979 (0.862)	0.389 (1.096)	−0.470 (0.761)
Cut 3	0.843 (0.486)	1.797 (0.845)	1.404 (1.126)	0.618 (0.766)
Cut 4	1.586 (0.502)	2.512 (0.897)		1.438 (0.815)
N	84	36	19	29
R^2 (pseudo)	0.01	0.032	0.034	0.047
Coefficient of treatment				
Oxytocin for low trust	0.519 (0.438)	1.096^{+} (0.718)	0.161 (1.089)	0.447 (0.684)
Oxytocin for medium trust	0.115 (0.244)	0.581^{+} (0.391)	0.173 (0.588)	−0.309 (0.425)
Oxytocin for high trust	−0.289 (0309)	0.066 (0.487)	0.184 (0.624)	−1.064 (0.651)
John McCain				
Oxytocin	0.319 (0.687)	1.288 (1.163)	0.652 (1.696)	0.056 (1.086)
Pre-treatment trust	0.465^{++} (0.200)	1.049^{++} (0.356)	0.646^{+} (0.451)	0.092 (0.374)
Oxytocin * pre-treatment trust	−0.184 (0.285)	−0.357 (0.478)	−0.239 (0.659)	−0.186 (0.496)
Cut 1	−0.731 (0.508)	0.272 (0.917)	−0.136 (1.162)	−1.337 (0.793)
Cut 2	0.194 (0.486)	1.831 (0.898)	0.526 (1.123)	−0.577 (0.759)
Cut 3	1.028 (0.490)	3.076 (0.964)	1.853 (1.192)	0.212 (0.743)
Cut 4	1.947 (0.512)	4.150 (1.017)	3.372 (1.303)	1.090 (0.782)
Cut 5	3.107 (0.591)	4.881 (1.087)		
N	86	37	19	30
R^2 (pseudo)	0.028	0.114	0.056	0.009
Coefficient of treatment				
Oxytocin for low trust	0.136 (0.428)	0.931^{+} (0.727)	0.413 (1.084)	−0.131 (0.656)
Oxytocin for medium trust	−0.048 (0.239)	0.574^{+} (0.399)	0.174 (0.582)	−0.317 (0.418)
Oxytocin for high trust	−0.231 (0.306)	0.216 (0.497)	−0.065 (0.610)	−0.503 (0.641)
Mitt Romney				
Oxytocin	0.948^{+} (0.698)	1.875^{+} (1.169)	0.578 (1.662)	1.702^{+} (1.158)
Pre-treatment trust	0.541^{++} (0.202)	0.756^{++} (0.341)	0.763^{++} (0.443)	0.593^{+} (0.394)
Oxytocin * pre-treatment trust	−0.441^{+} (0.289)	−0.791^{+} (0.483)	−0.308 (0.649)	−0.848^{+} (0.526)
Cut 1	−0.170 (0.494)	0.644 (0.860)	0.367 (1.093)	−0.247 (0.783)

Table 4 continued

Variable	Whole sample coefficient (SE)	Democrats coefficient (SE)	Republicans coefficient (SE)	Independents coefficient (SE)
Cut 2	0.585 (0.484)	1.570 (0.878)	1.203 (1.099)	0.329 (0.762)
Cut 3	1.594 (0.505)	2.798 (0.934)	2.031 (1.166)	1.528 (0.816)
Cut 4	2.348 (0.533)	3.583 (0.988)	3.205 (1.243)	2.672 (0.896)
Cut 5	3.290 (0.597)			
N	85	37	19	29
R^2 (pseudo)	0.028	0.049	0.066	0.034
Coefficient of treatment				
Oxytocin for low trust	0.507 (0.435)	1.084^{+} (0.725)	0.270 (1.060)	0.854 (0.697)
Oxytocin for medium trust	0.066 (0.241)	0.293 (0.389)	−0.038 (0.570)	0.007 (0.429)
Oxytocin for high trust	−0.375 (0.306)	−0.499 (0.492)	−0.347 (0.606)	−0.841 (0.661)

Standard errors in parentheses

$^{++}$ $p \leq .05$ (one-tailed); $^{+}$ $p \leq .10$ (one-tailed); ** $p \leq .05$ (two-tailed); * $p \leq .10$ (two-tailed)

very small sample of Republicans in our study and more work would need to be done to fully explain the null findings for this group. It appears then that OT may extend to trusting political figures, but only among certain individuals. In the next section, we evaluate whether the effects of OT on trust extend to more abstract concepts, namely the federal government.

Trust in Government

Since individuals do not form a social bond with government institutions, we may not observe a strong effect of OT on trust in government. As we discussed earlier, it is possible that any positive effect of OT on trust in government may be moderated by interpersonal trust and partisanship. To measure trust in government, we asked subjects how much of the time they can trust the government in Washington to do what is right, and the response options were: always, most of the time, only some of the time, or none of the time. This measure is akin to measures of trust in government used in political science surveys (e.g., Brehm and Rahn 1997; Lipset and Schneider 1983; Hetherington 1998, 1999) and is included on the American National Election study. A more general evaluation measure asked how satisfied the individual is with the way the government is operating in Washington on a seven-point satisfaction scale (Hetherington 1999). We combine both measures into one using principal components factor analysis and higher values mean more trust and more satisfaction.[18]

We run the same type of models as we reported in the previous section, though this time using OLS given that the dependent variable is continuous, and the results

[18] Only one factor emerged with an eigenvalue over 1 and both measures had similar weights.

Table 5 OLS regression on trust in and satisfaction with the federal government by partisan group

Variable	Whole sample Coefficient (SE)	Democrats Coefficient (SE)	Republicans Coefficient (SE)	Independents Coefficient (SE)
Trust in government				
Oxytocin	1.146^{++} (0.645)	2.493^{++} (1.101)	−0.872 (1.523)	0.539 (0.947)
Pre-treatment trust	0.547^{++} (0.185)	0.770^{++} (0.316)	0.267 (0.382)	0.417 (0.326)
Oxytocin * pre-treatment trust	-0.510^{++} (0.267)	-0.904^{++} (0.457)	0.176 (0.589)	−0.328 (0.432)
Constant	−1.229** (0.449)	−1.960** (0.816)	−0.086 (0.985)	−1.058 (0.651)
N	86	37	19	30
R^2	0.0972	0.1733	0.1367	0.0628
Coefficient of treatment				
Oxytocin for low trust	0.636^{+} (0.402)	1.589^{++} (0.684)	−0.696 (0.974)	0.211 (0.571)
Oxytocin for medium trust	0.127 (0.224)	0.686^{++} (0.373)	−0.520 (0.520)	−0.116 (0.357)
Oxytocin for high trust	−0.383 (0.286)	−0.218 (0.479)	−0.345 (0.535)	−0.444 (0.550)

Standard errors in parentheses

$^{++}$ $p \leq .05$ (one-tailed); $^{+}$ $p \leq .10$ (one-tailed); ** $p \leq .05$ (two-tailed); * $p \leq .10$ (two-tailed)

are displayed in Table 5. For the whole sample, we find that OT increases trust in and satisfaction with the federal government among those who came to the lab with the lowest level of interpersonal trust ($p = 0.059$, one-tailed). When we break the analysis down by partisanship, we can see that Democrats are driving the results. OT increases trust in the federal government (relative to those on placebo) by 1.59 units among Democrats at the lowest level of interpersonal trust ($p = 0.013$, one-tailed) and by .69 units among Democrats at the middle level of interpersonal trust ($p = 0.038$, one-tailed). These are fairly substantial effects for a dependent variable that ranges from −2.2 to 3.2. These results again lend more support to the hypothesis generated from the neuropolitics literature in that we only observe effects among Democrats. Even if people think of the federal government in terms of people, they would have been thinking of the incumbent, George W. Bush, who is not a member of the same "team."

Discussion and Conclusions

Our study finds that there is some biological basis for interpersonal trust, as well as trust in government and political leaders. Individuals on OT are more likely to agree that most people can be trusted compared to those on placebo. For trust in specific political actors and government, the effects of OT are moderated by pre-treatment interpersonal trust and by partisanship. More specifically, the effects of OT

primarily obtain for Democrats who came to the study with lower initial ratings of interpersonal trust.

The results show that the release of OT may be most consequential among those who start out with a lower propensity to trust others. Meanwhile, individuals who start out with higher levels of interpersonal trust will be less affected by its release in their trust assessments of political actors and government. These findings are very important, particularly given the way in which OT operates. It suggests that individuals with a "symptom" of being low in trust can have a much bigger increase in trust in political actors and government, given an external environment that stimulates the release of OT.

The more novel findings have to do with how the effects of OT vary by partisanship. Democrats are more susceptible to OT in general, regardless of the partisanship of the political figure. These findings differ from standard understandings of partisanship serving as a filter in the political behavior literature. Democrats on OT low in interpersonal trust are more trusting of Democratic *and* Republican political figures compared to their counterparts in the placebo condition, though many of these effects are marginal or suggestive. They are also more trusting of the federal government, even though George W. Bush, a Republican, was at the helm at the time of our study. While these findings stand in stark contrast to those that would generally be expected from the political behavior literature, they comport with some of the more nascent literature in neuro-politics that suggests that OT's pro-social influence should have a greater impact for those on the left, since they are more greatly influenced by others. Our study leads us to expect that the effects of OT among Democrats may hold across a range of other dependent variables that have a social element, such as political persuasion, deliberation with others, and political participation.

There are some limitations to the current study that affect the extent to which we are able to generalize these findings. We were only able to explore the relationship between OT, interpersonal trust, and trust in government in males. It is not necessarily the case that these relationships will work in the same way for females. We did not include females in the sample given the risk factors of administering OT to pregnant women, but, as we elaborate on below, we suspect the effects may be even more pronounced among females. Furthermore, it could be that our very diverse student sample reacts differently to OT and politics than non-student adults. However, OT appears to function consistently across all ages (Barraza et al., in progress) and racial and ethnic groups.[19] The bigger problem when dealing with a student sample is that we had a smaller sample of Republicans. Our findings for Democrats may have resulted from having simply more subjects that fit into this category. However, we think this is unlikely because the general pattern of results among Republicans was not suggestive of any positive effects of OT on trust in

[19] Previous work on OT infusion has tested for racial or ethnic differences in response to OT and no effects have been found (Morhenn et al. 2008; Zak et al. 2005a, b; Zak et al. 2007). As another check for external validity, we ran all of our analyses using race and ethnicity dummy variables and in only two cases do we find that the Asian dummy variable is statistically significant and its inclusion washes away the effect of OT. This is in the analysis of trust in George Bush and trust in Mitt Romney among Democrats.

political actors and institutions, and social influences appear to have a diminished role among Republicans (Amodio et al. 2007; Dodd et al. 2011).

We were able to look at the relationship between OT and trust in government actors and institutions by infusing a random sample of participants with OT. Outside the laboratory, individuals are not infused with OT; rather, it is released in response to different social stimuli. Variation in the release of oxytocin may help explain why we observe different levels of trust in others and trust in politics across individuals and societies. An important question that follows from our study is how environmental stimuli might affect the release of OT and whether release varies across different types of individuals.

The human OT system appears to activate for a larger variety of stimuli than other mammals (Zak 2011). For the hundreds of people from whom blood has been drawn to assess if they release OT after a positive social stimulus, 95 % do. This includes participants in a variety of laboratory experiments and ecologically valid field experiments in response to positive stimuli such as weddings, religious services, and soldiers marching (Zak 2012). These findings might lead us to question whether OT really helps us understand variation in trust across societies since its release is so pervasive. That being said, the range of social stimuli present in the environment is likely to vary across societies, which may affect the depth of trust that is observed. For example, the neurochemical interactions of OT predict that societies experiencing good economic times will exhibit more trust in government and government actors. The results on OT release combined with our findings suggest that politicians can try to create a bond with the public through patriotic displays, such as soldiers marching.[20] Zak and colleagues have shown that highly emotional speech (Barraza and Zak 2009), public events (Geddes 2010; Zak 2012) and advertisements (Lin et al., in press), stimulate the release of OT. When these stimuli are focused on a political candidate, this may boost trust in the candidate.[21]

In addition to potential variation across societies, there is evidence of variation in OT release in humans for the same stimulus (Zak 2011). As a result, there may be some who respond more strongly to social stimuli to initiate trust (Zak et al. 2005) in government. While studies have not found consistent differences in OT release across different age groups, racial and ethnic groups, or partisan groups (Zak 2012),[22] most experiments show that women release more OT for the same stimulus than do men, as do those higher in trait empathy (Barraza and Zak 2009). While we did not include women in our study for safety reasons, we suspect that we would have had even larger effects of OT on support for government actors and institutions if we did, since women are even more likely to identify with the Democratic Party

[20] This stimuli brings to mind the iconic image of authoritarian regimes. Such displays may therefore not only convey the power of the regime, but foster bonds of trust with the public in these societies.

[21] It is important to note that the temporal effects of any OT-induced changes in trust remain unclear. An individual's feelings of trust may return to previous levels as OT is metabolized. Alternatively, feelings held during hormonally spiked experiences may be encoded and permanently alter beliefs.

[22] This is based on studies from our lab. Since it is a non-result, it is unpublished.

than men,[23] and our effects obtained primarily among Democrats. If OT release is greater among women in response to positive stimuli and they increase their engagement with politics, then trust in government and government actors may improve. While this may not make a big difference for aggregate trust in the U.S. context, it may be important in societies with traditionally low levels of female participation that are becoming more inclusive with respect to women.

While positive social stimuli are likely to boost OT, particularly among women, high stress levels inhibit the release of OT (Bremner et al. 1995). This relationship may help explain why we observe lower trust in societies high in poverty (Zak and Knack 2001) and high in crime (Halpern 2001). Both poverty and crime create high stress environments for the public. Some research also suggests that conservatives have a larger stress response than liberals (Oxley et al. 2008); which in turn may further inhibit the release of OT, leading to lower trust in government.

The role of biological factors in political attitudes and behaviors is a new area of research, and more work needs to be done on the links between OT and trust in government actors and institutions, particularly with respect to endogenous OT release. How might political candidates affect the release of OT? Are there particular social and political environments that increase or inhibit the release of OT? Are there other individual level factors that lead to differential release of OT in response to the same stimuli? Existing research has looked for differences by age, gender, race and partisanship, but there are other potential individual level factors that may be relevant, such as ideology, trait anxiety, and authoritarian predispositions that should also be examined.

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[23] See for example the Pew Center for People and the Press, "The Gender Gap: Three Decades Old, as Wide as Ever." Accessed on December 17, 2012, at http://www.people-press.org/2012/03/29/the-gender-gap-three-decades-old-as-wide-as-ever/.

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