Increased Temporal Discounting in Social Anxiety Disorder Normalizes after Oxytocin Treatment

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Social anxiety disorder (SAD) is a highly pernicious and disabling condition with a lifetime prevalence of >12% [1]. Current cognitive models highlight increased attentional and interpretive biases toward social stimuli as key factors in the etiology of SAD [2]. In accord with this are neurocircuitry models of SAD which emphasize overreactivity of the amygdala and resultant hyperattention to social stimuli due to deficient cognitive (top-down) control [3]. Of particular relevance in this context are findings that anxious temperament is associated with aberrant reward-based valuation, with the latter serving to control for nonspecific anxiety-related changes in reward processing. Anxiety and depression symptoms as well as social connectedness were measured via questionnaires (see also in the online suppl. section “Results” and online suppl. Table S1).

All procedures contributing to this work complied with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

A mixed design analysis of variance with the between-subject factors “treatment” (OXT, PLC) and “group” (SAD, CTL), the within-subject variable “relative difference” between sooner-smaller and later-larger options (0.5 to 75%), and the proportion of patient choices (later-larger) as dependent variable yielded significant main effects of relative difference (F(1,35, 235,59) = 89.02, p < 0.01, η² = 0.57; Fig. 1a) and treatment (F(1,46) = 6.17, p = 0.02, η² = 0.09) as well as a trend-to-significant effect of group (F(1,46) = 3.36, p = 0.07, η² = 0.05). There were no further interactions (all p values > 0.17). Thus, participants chose the later-larger option more often when there was a greater relative difference in sooner-smaller/later-larger magnitudes.

OXT significantly increased the patient choices (later-larger) across all participants. Separate analyses in the OXT and PLC groups revealed that SAD patients showed more impulsive preferences under PLC compared to CTL (F(1,34) = 4.45, p = 0.04, η² = 0.12), while there was no such difference after OXT treatment (F(1,32) = 0.34, p = 0.56, η² = 0.01). This pattern of results was confirmed in an additional analysis with the discounting parameter k as dependent variable, demonstrating a main effect of treatment (F(1,64) = 5.52, p = 0.02, η² = 0.08) and a trend-to-significant effect of group (F(1,64) = 3.78, p = 0.06, η² = 0.06; Fig. 1b).

Interestingly, across all groups, social connectedness positively correlated with the proportion of patient choices in the PLC condition (r(35) = 0.30 p = 0.07; OXT: r(35) = 0.16, p = 0.36), indicating that individuals with less social connections less often restrained from choosing the sooner-smaller option. This is in line with proposals that reduced social connectedness may lead to decreased cognitive control, since social support is a robust stress buffer, and the experience of social exclusion impairs self-regulation [7]. There was no significant main or interaction effect of treatment in the valuation control task (see also online suppl. section “Results” and online suppl. Table S2), indicating that OXT did not alter the valuation of rewards options.

CONSORT flow diagram and check list in the online suppl. section “Material”; see www.karger.com/doi/10.1159/000495259 for all online suppl. material in which 33 medication-free patients with SAD (25 females; age 31.21 ± 11.43 years) and 37 healthy controls (CTL; 31 females; age 34.46 ± 14.45 years) with no current or past physical or psychiatric illness self-administered intranasal OXT (24 IU) or placebo (PLC). The participants were first tested on a social interaction task (the results have been reported elsewhere).

Then, they performed a temporal discounting task and a reward valuation, with the latter serving to control for nonspecific anxiety-related changes in reward processing. Anxiety and depression symptoms as well as social connectedness were measured via questionnaires (see also in the online suppl. section “Results” and online suppl. Table S1).

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therapy. Considering the relevance of increased temporal discounting in SAD, it seems important that these disorder-tailored approaches motivate patients to resist the urge of avoidance (negative reinforcement) and focus on the delayed social rewards that can be achieved by fear exposure.

In conclusion, our data indicate that SAD associated with reduced social connectedness affects intertemporal choice of monetary rewards, and intranasal OXT induces a preference for more patient choices. As such, beyond pure anxiolysis, OXT signaling may also play a role in the cognitive control of prepotent impulses during reward-based decision-making.

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Conflict of Interests
The authors report no competing biomedical financial interests or personal affiliations in connection with the content of this manuscript.

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