Preliminary evidence that sub-chronic citalopram triggers the re-evaluation of value in intimate partnerships

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Depression frequently involves disrupted inter-personal relationships, while treatment with serotonergic anti-depressants can interfere with libido and sexual function. However, little is known about how serotonin activity influences appraisals of intimate partnerships. Learning more could help to specify how serotonergic mechanisms mediate social isolation in psychiatric illness. Forty-four healthy heterosexual adults, currently in romantic relationships, received 8 days treatment with the selective serotonin re-uptake inhibitor citalopram (N = 21; 10 male) or placebo (N = 23; 12 male). Participants viewed photographs of unknown, heterosexual couples and made a series of judgements about their relationships. Participants also indicated the importance of relationship features in their own close partnerships, and close partnerships generally. Citalopram reduced the rated quality of couples’ physical relationships and the importance attributed to physical and intimate aspects of participants’ own relationships. In contrast, citalopram also enhanced the evaluated worth of mutual trust in relationships. Amongst males, citalopram was associated with judgements of reduced turbulence and bickering in others’ relationships, and increased male dominance. These data constitute preliminary evidence that enhancing serotonin activity modulates cognitions about sexual activity as part of a re-appraisal of sources of value within close intimate relationships, enhancing the judged importance of longer-term benefits of trust and shared experiences.

Keywords: serotonin; intimate relationships; social isolation; social judgements; depression

INTRODUCTION

Individuals with affective disorders frequently experience troubled social lives (Pattison et al., 1975; Brugha et al., 1982; Billings et al., 1983; Keitner et al., 1987). The inter-personal disturbances experienced by depressed individuals are particularly prominent in close intimate relationships (Weissman et al., 1974; Fredman et al., 1988). An important research tradition identifies dysfunctional and conflicted intimate relationships as significant stressors and precursors of clinical illness in vulnerable individuals (Malarkey et al., 1994; Kiecolt-Glaser et al., 1997; Miller et al., 1999; Newton and Sanford, 2003; Hollist et al., 2007).

Despite the salience of intimate partnerships in the clinical presentation of depression, we know little about the neurochemical mechanisms that mediate how individuals think about the quality of these relationships. Learning more could help us to specify how the biological mechanisms that confer vulnerability to depression (and other psychiatric illnesses) (Bhagwagar and Cowen, 2008) are linked to social isolation or dysfunctional inter-personal relationships that increase the risk of clinical illness and/or relapse (Bilderbeck et al., 2011).

Observational and experimental investigations in non-human primates indicate that the neuromodulatory influences of serotonin influence the expression of adaptive affiliative behaviours, including success in locating and securing mating partners within social hierarchies (Mehlman et al., 1995; Higley et al., 1996; Higley and Linnoila, 1997; Mehlm et al., 1997). In humans too, serotonin activity seems to influence strategies in behavioural models of economic exchanges (Wood et al., 2006; Crockett et al., 2008). Serotonergic antidepressants can influence the social behaviour of healthy people (Knutson et al., 1998; Tse and Bond, 2002a,b; Knorr et al., 2012); for example, decreasing self-reported hostility (Knutson et al., 1998) while increasing agreeableness and conscientiousness (Knorr et al., 2012), and promoting affiliative behaviours (Knutson et al., 1998; Tse and Bond, 2002b). Binding of 5-HT2A receptors in the anterior cingulate and orbitofrontal cortices, areas related to emotion and motivation, shows negative correlations with self-reported desire for social relationships, offering one pharmacological mechanism by which altered serotonin activity might influence social cognition and behaviour (Gerretsen et al., 2010). Carriers of the short allele of the serotonin transporter-linked polymorphic region (5-HTTLPR) exhibit enhanced BOLD amplitudes within the amygdala while viewing pictures of a ‘favourite person’ (Matsunaga et al., 2010), suggesting that genotypes associated with modulated serotonin availability influence the neural signalling of preferred social partners.

The above (broadly) naturalistic or associative evidence tells us little about how serotonin activity contributes to cognitions involving close intimate relationships. To address this, we developed the Couples Appraisal Task (CAT) in which participants are shown photographs of male and female adults, posed as couples, and then invited to provide simple ratings of different relationship attributes. Variability in the ratings of relationship attributes can reflect gender-specific factors, situational characteristics such as whether couples were pictured touching or standing apart, and raters’ own attachment styles (Bilderbeck et al., 2011). In a first experiment, we found that tryptophan depletion in healthy adults reduced the appraised ‘intimacy’ and ‘romance’ of couples and, in female participants, enhanced the rated ‘dominance’ of the male over female partner in each couple (Bilderbeck et al., 2011). Overall, these initial findings suggest that fluctuating serotonin activity can influence judgements about the characteristics of close intimate partnerships, and appraisal of these relationships in terms of gender-specific roles such as the relative dominance of male and female partners.

Here, we investigated the effects of enhancing serotonin activity upon the appraisal of close intimate relationships. Healthy adults,
with no history of depression, received 8 days treatment with the selective serotonin reuptake inhibitor (SSRI) citalopram or an inactive placebo before completing a modified version of the CAT. We tested three hypotheses. First, given our previous findings with tryptophan depletion (Bilderbeck et al., 2011), we wished to test whether increasing serotonin availability by way of citalopram treatment would alter—perhaps, even enhance—appraisals of ‘intimacy’ and ‘romance’ in close partnerships, but reduce ratings of attributes indicating interpersonal conflict, such as ‘turbulence’ and ‘bickering’. We also sought to test whether citalopram modulates individuals’ appraisals of power and dependence in intimate relationships in terms of the rated ‘dominance’ of male and female partners, and the relative degree to which each are judged to be in love with the other.

Second, SSRI s can diminish sexual desire and impact upon sexual function in clinical (Montejo-Gonzalez et al., 1997; Goldstein and Goodnick, 1998; Rosen et al., 1999; Corona et al., 2009) and non-clinical samples (Montejo et al., 2010). However, it is unknown whether SSRI s can also alter judgments about sexual intimacy more generally. So, we sought to test the hypothesis that increasing serotonin activity by way of sub-chronic citalopram treatment would modulate judgments about the ‘physical relationships’ of other couples.

Finally, accumulating evidence suggests that serotonin activity plays a role in modulating depressive states through the relative activation, following treatment with antidepressants, of positive and negative cognitive biases (for a review, see Harmer et al., 2009). As part of this, we hypothesized that serotonin activity influences, not only processing of memories for positive and negative social signals or personal attributes (Harmer et al., 2003b, 2004), but appraisals of the importance of different relationship features. Therefore, we asked participants to rate their current partnerships on a sub-set of positive and negative attributes, and to rank the importance of those attributes in maintaining healthy intimate relationships generally.

METHODS
The study was approved by the local NHS research ethics committee. All participants provided written, fully-informed consent in accordance with the Declaration of Helsinki.

PARTICIPANTS
Forty-four healthy adults (22 males; 22 females) took part. Participants were assessed, using a semi-structured SCID-1 interview (First et al., 2002), against exclusion criteria including the presence or history of serious physical or psychiatric illness (including mood disorders). Pregnancy was an exclusion criterion, and female volunteers underwent a pregnancy test immediately before treatment. Inclusion criteria required that participants were in a current heterosexual relationship of at least 4 months. Information about menstrual cycle was collected in genuine relationships at the time of the study and gave consent for their photographs to be taken. Selected photographs are reproduced here with permission.

Participants rated each couple, without time limits, using visual analogue scales (VASs) for relationship descriptors presented alongside their photograph in the computer display (see Supplementary Figure 1). Following Bilderbeck et al. (2011), descriptors included ‘intimate’; ‘romantic’; ‘supportive’; ‘trusting’; ‘conflict resolution’, ‘enduring’ and ‘good physical relationship’, using ‘Not at all’ and ‘Very’ as anchor points. However, the rCAT also included two descriptors to capture negative relationship characteristics, ‘turbulence’ and ‘bickering’ (using the same anchor points as above), and two descriptors selected to tap the balance of power or emotional engagement between partners: ‘dominance’ (Which partner, male or female, tends to be more dominant?) and ‘balance of love’ (Which partner, male or female, might be more in love?). These latter two scales were labelled with ‘Man’ on the extreme left and ‘Woman’ on the extreme right, with ‘Neutral’ at the midpoint. All 25 photographs were presented in the same order for all participants; however, the younger and the older couples were distributed equally across the early and later photographs in the sequence. The complete set of rCAT items are listed in Supplementary Table 1.

Control ratings
Participants provided three control ratings. First, 39 participants (20 placebo, 19 citalopram) rated their own current close partnerships using the items of the rCAT. Second, since both acute and sub-chronic
treatments with citalopram can modulate judgments about emotional facial expressions (Harmer et al., 2003a, 2004), and since such effects could influence relationship ratings in the rCAT, all participants were asked to rate how happy the couples appeared on the basis of their facial expressions, using a VAS with labels ‘Not at all’ and ‘Very’ as anchor points. Finally, to ensure that we could detect whether citalopram influenced more basic perceptual judgements, we asked participants to use a final VAS to estimate how far apart the partners were standing from one another.

Importance of relationship features questionnaire
Following completion of the rCAT, a subset of 39 participants (20 placebo, 19 citalopram) rated the importance of the relationship features, taken from the rCAT, in their own current relationship, using continuous VAS scales with labels ‘Not at all’ and ‘Very much’ as anchor points. Participants also ranked these features in terms of relative importance for healthy relationships, in general. A full list of Importance of Relationship Features Questionnaire (IRFQ) items is provided in Supplementary Table 2.

Statistics
Full details of the statistical analyses are provided in the Supplementary Materials. Following previous work, participants’ ratings of descriptors selected to reflect the perceived stability of close relationships—i.e. ‘intimacy’, ‘romance’, ‘support’, ‘trust’, ‘enduring’, ‘physical relationship’ and ‘conflict resolution’—for the photographed couples and their own relationships were analysed with multivariate analysis of variance (MANOVA) with the two between-subjects factors of treatment and gender. (Bivariate correlations of rCAT items are shown in Supplementary Table 3). Ratings for items for which we hypothesized treatment differences (‘intimacy’ and ‘physical relationship’) were tested using univariate ANOVAs. ‘Dominance’ and ‘balance of love’ ratings were tested with univariate ANOVAs and one-sample t-tests against a midline test value of 0 (indicating equality between male and female partners). Finally, participants’ importance ratings, collected in the IRFQ, were analysed in the same way as the rCAT ratings. Participants’ rankings of the importance of relationship attributes were tested using non-parametric Mann–Whitney tests.

RESULTS
Group-matching, demographics and psychometrics
Participants in the citalopram and placebo treatment groups were well-matched for age, cognitive ability and positive and negative trait affect (Table 1), all Fs (1,40) < 2.27. As intended, participants who received citalopram and participants who received placebo were closely matched in terms of the length of their current romantic relationships (means ± standard errors [SE]: 2.11 ± 0.41 vs 2.11 ± 0.24 years, respectively), F (1,40) < 1. Participants were also well-matched on the quality of these relationships, as measured by the RDAS (Busby et al., 1995) (36.41 ± 0.59 vs 35.48 ± 0.48), F (1,40) = 1.49; although females rated the quality of their relationships as higher than male participants (37.14 ± 0.43 vs 34.71 ± 0.51), F (1,40) = 12.84, P = 0.001. Finally, there were no significant baseline group differences in terms of the rated passion (and physical intimacy) of their current relationship amongst those participants who completed the Passionate Love Scale (7.19 ± 0.39 vs 7.80 ± 0.26), F (1,33) = 1.86.

Consistent with previous experiments (Harmer et al., 2004; Browning et al., 2011), there were no significant changes in positive or negative state affect between the first and eighth treatment day following citalopram compared with placebo treatment, F (1,40) < 1 and F (1,40) = 1.40, respectively. Citalopram- and placebo-treated participants reported very similar positive, F (1,40) < 1, and negative state affect, F (1,40) = 1.08, on the eighth (testing) day (Table 1).

Revised couples appraisals task
Mean ratings for the seven rCAT items related to general relationship stability provided by the citalopram-treated and placebo-treated participants are shown in Figure 1. MANOVA of these items showed no effect of treatment on ratings of ‘bickering’ were also moderated by gender (Figure 2), F (1,40) = 4.15, P = 0.048. Male participants

Fig. 1 Upper panel: two photographs taken from the rCAT. Participants viewed digital photographs of 25 heterosexual couples, roughly matched for age between the male and female partner (between 18 and 75 years). Lower panel: mean ratings of relationship characteristics provided by 21 healthy adults who received 20 mg citalopram per day for 8 days (coloured triangles) and 23 healthy adults who received placebo (black circles). Error bars: ±1 SE. *P (1,40) = 4.37, P < 0.05.

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receiving citalopram treatment provided significantly lower rCAT ratings of turbulence, \( F(1,20) = 7.096, P = 0.015 \) and bickering (Figure 2), \( F(1,20) = 4.89, P = 0.039 \), compared with male participants receiving placebo treatment.

**Dominance and balance of love**

Citalopram treatment also influenced male, but not female, participants’ ratings of dominance when making judgements about other couples’ relationships, \( F(1,20) = 4.936, P = 0.038 \). Male participants who received citalopram judged the male partners in the photographs to be, on average, the more dominant partner, \( t(9) = -2.96, P = 0.016 \), whilst male participants who received the placebo rated the males and females as having roughly equal dominance (Figure 3), \( t(11) = 0.71, P = 0.49 \). Overall, female participants also tended to rate the females in the photographs as the more dominant partner, compared with male participants, \( F(1,40) = 7.42, P = 0.009 \).

Finally, citalopram influenced ratings of the ‘balance of love’ differently in male and female participants, \( F(1,40) = 5.04, P = 0.030 \). Male participants who received placebo judged the male partners in the photographs as being more in love than the female partners while female participants who received placebo rated the female partners as being more in love than the male partners, \( F(1,20) = 5.35, P = 0.031 \). However, citalopram-treated males and females judged the male and female partners to be roughly equally in love (Figure 3), \( F(1,19) < 1 \).

**Control ratings**

Citalopram- and placebo-treated participants did not differ in the appraised qualities of their own relationship using the rCAT items, including rated quality of the physical relationship with their current partners (Supplementary Table 5), all \( Fs(1,35) < 2.14, Ps > 0.15 \). Citalopram did not markedly influence participants’ judgments about how happy the couples looked compared with placebo (50.82 ± 1.14 vs 52.20 ± 1.62), \( F(1,40) < 1 \). Finally, the citalopram- and placebo-treated participants provided similar ratings of how close the partners were standing to one another (52.78 ± 1.12 vs 55.63 ± 1.17), \( F(1,40) = 1.76 \).

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**Table 1** Mean (± SE) age, cognitive ability (Raven’s Matrices scores), trait positive and negative affect scores (PANAS), and state positive and negative affect measured at baseline (first day) and on the testing day (eighth day) for 21 healthy adults who received 20 mg of citalopram for 8 days, and 23 healthy adults who received placebo.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Placebo</th>
<th>Citalopram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (M/F)</td>
<td>12/11</td>
<td>10/11</td>
</tr>
<tr>
<td>Age (years)</td>
<td>22.57 ± 1.00</td>
<td>22.62 ± 0.65</td>
</tr>
<tr>
<td>Raven’s Matrices</td>
<td>56.82 ± 0.64</td>
<td>56.40 ± 0.57</td>
</tr>
<tr>
<td>PANAS (trait)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>36.52 ± 0.96</td>
<td>34.43 ± 0.97</td>
</tr>
<tr>
<td>Negative</td>
<td>12.92 ± 0.55</td>
<td>13.33 ± 0.66</td>
</tr>
<tr>
<td>PANAS (state)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day 1 Positive</td>
<td>31.17 ± 1.01</td>
<td>32.05 ± 1.38</td>
</tr>
<tr>
<td>Day 1 Negative</td>
<td>12.57 ± 0.91</td>
<td>12.48 ± 0.62</td>
</tr>
<tr>
<td>Day 8 Positive</td>
<td>29.83 ± 1.36</td>
<td>30.10 ± 1.67</td>
</tr>
<tr>
<td>Day 8 Negative</td>
<td>11.52 ± 0.59</td>
<td>12.48 ± 0.67</td>
</tr>
</tbody>
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**Fig. 2** Mean ratings of judged ‘turbulence’ (left) and ‘bickering’ (right) measured in the rCAT provided by 21 healthy adults who received 20 mg per day citalopram for 8 days (green bars) and 23 healthy participants who received placebo (blue bars). Error bars = +1 SE. *\( F(1,20) = 7.096, P < 0.05 \); **\( F(1,20) = 4.89, P < 0.05 \).

**Fig. 3** Mean ratings of judged ‘dominance’ (left) and ‘balance of love’ (right) between photographed partners in the rCAT provided by 21 healthy adults who received 20 mg per day citalopram for 8 days (green bars) or 23 healthy adults who received placebo (blue bars). Error bars = +1 SE. *\( F(1,20) = 4.936, P < 0.05 \); **\( F(1,20) = 5.35, P < 0.05 \).

**Importance of different relationship features**

Citalopram-treated individuals rated ‘intimacy’ and a good ‘physical relationship’ as less important in their own relationship than placebo-treated participants (intimacy: 80.00 ± 2.11 vs 85.30 ± 2.19, respectively, \( F(1,35) = 4.36, P = 0.044 \); physical relationship: 72.95 ± 3.28 vs 81.10 ± 2.22, respectively, \( F(1,35) = 4.49, P = 0.041 \) (Supplementary Table 6).

However, citalopram and placebo produced markedly different rankings of the importance of relationship attributes. Participants who received citalopram ranked ‘mutual trust’ as more important in relationships than did participants who received placebo (median rank: 2 vs 1) (Figure 4), \( U = 114.00, P = 0.033 \). Citalopram-treated participants also tended to rank a relationship’s capacity to ‘endure’ as more important compared with the placebo-treated participants (median rank: 9 vs 7), \( U = 123.00, P = 0.061 \). In contrast, the citalopram-treated participants ranked ‘intimacy’ as generally less important than the placebo-treated participants (median rank: 2 vs 4.5) (Figure 4), \( U = 104.00, P = 0.015 \).
DISCUSSION

Increasing serotonin availability via sub-chronic citalopram treatment influenced healthy adults’ appraisals of close intimate partnerships in a number of ways. Our findings complement our earlier report that temporary reductions in serotonin activity (achieved by tryptophan depletion) alter similar judgements about close personal relationships (Bilderbeck et al., 2011), but extend those data by demonstrating a role for serotonin activity in modulating judgements about the importance, or value, attributed to different relationship features. These findings, therefore, point to an important role for this neurotransmitter system in meta-cognitive judgements about intimate partnerships.

Treatment-related changes in participants’ judgements about relationships could not be attributed to pre-existing group differences in cognitive ability, trait affect, or the duration, judged quality, or physical intimacy of participants’ current significant partnerships; the two treatment groups were closely matched for these features. Similarly, our findings cannot be accounted for by gross changes in state mood, or participants’ ability to make judgements about photographed individuals’ emotional expressions or their physical proximity following citalopram treatment compared with placebo treatment. Rather, our results point to specific associations between serotonergic availability and individuals’ cognitions about close intimate partnerships.

Citalopram and opposing judgements about intimacy/sexual activity vs trust

Temporary reductions in central serotonin activity (achieved by tryptophan depletion) and enhancement of serotonin activity (achieved by treatment with SSRIs) can produce opposing and complementary effects upon emotion recognition and memory in healthy adults (Harmer et al., 2009). However, contrary to our hypotheses, we did not find that citalopram treatment enhanced ratings of ‘intimacy’ or ‘romance’ in couples’ relationships. Possibly, relationship appraisals are linked to serotonin activity in non-linear ways, such that the judgements about intimacy and romance made by healthy adults may be more sensitive to reductions in serotonin activity achieved by tryptophan depletion, as we previously observed (Bilderbeck et al., 2011), than they are to the increased serotonin availability achieved by sub-chronic SSRI treatment. If so, citalopram could still produce positive changes in intimacy and/or romance ratings in individuals with diagnoses of mood disorders, such as depression, that are linked to an underlying serotonergic disturbance (Bhagwagar et al., 2004, 2006).

Although citalopram treatment did not enhance participants’ ratings of couples’ intimacy, it did influence their judgements about the importance of intimacy and their appraisals of sexual interactions. Citalopram-treated participants rated the ‘physical relationship’ of the pictured couples as significantly poorer than the placebo-treated participants. They also judged a good ‘physical relationship’ as significantly less important in their own relationships, and ranked ‘intimacy’ as significantly less important in close partnerships more generally. There are at least two ways to view these changed appraisals of sexual relationships.

First, these observations may be related to the well-documented and deleterious side-effects of SSRIs on libido and sexual function (Goldstein and Goodnick, 1998; Rosen et al., 1999; Corona et al., 2009; Montejo et al., 2010). However, in this experiment, citalopram did not significantly diminish the rated quality of participants’ own physical relationships with their current partners compared to placebo. Given that our protocol involved a relatively brief, 8-day treatment period, it is possible that the effects of citalopram administration upon participants’ sexual activity with their own partners had not yet fully emerged (Montejo et al., 2010), but that the rCAT ratings were sufficiently sensitive to detect subtle alterations in inter-personal cognitions about sexual activity. Alternatively, participants may have felt uncomfortable reporting changes in their sexual relationships in our assessments. If so, ‘indirect’ instruments, such as the ratings of the rCAT, may be more successful in tapping sensitive areas of relationship function than direct questioning.

Second, the altered ratings of the importance of good physical relationships may form only part of a broader adjustment of cognitions about close intimate relationships following anti-depressant treatment. Citalopram-treated individuals rated ‘mutual trust’ and (at a marginally-significant level) the capacity of a close relationship to ‘endure’ as being relatively more important in the functioning of healthy relationships than placebo-treated participants. This suggests that the deleterious effects of SSRI treatment upon sexual function and libido trigger a broader reappraisal of the sources of value within close intimate relationships, potentially enhancing the importance attributed to longer-term benefits associated with repeated, shared experience.

Other evidence suggests that anti-depressant treatments have their therapeutic effects via the activation of positive cognitive biases and the (relative) deactivation of negative biases, and that this rebalancing process can precede overt changes in mood (Harmer et al., 2004, 2008). Our present findings suggest that this rebalancing between positive and negative cognitive biases also involves recalibrating what is judged important in close personal relationships, possibly helping to mediate the positive changes in social function frequently observed in recovered patients (Kocsis et al., 1988, 1997; Weissman, 2000).

Citalopram and judgements about inter-partner conflict

Citalopram also produced significant reductions in ratings of ‘bickering’ and near-significant reductions in ratings of ‘turbulence’ in relationships among male compared with female participants. Serotonin activity is linked to the modulation of aversive processing and inhibitory operations following negative prediction errors (Deakin and Graeff, 1991; Dayan and Huys, 2008; Crockett et al., 2009; Dayan and Huys, 2009; Cools et al., 2011; Crockett et al., 2012), raising the possibility that, in males at least, enhancing serotonin activity subdued ratings of inter-personal conflict and endorsement of negative relationship descriptors through broad modulation of ‘aversive’ processing, rather than specific effects on social cognition. Similarly, the judgments of reduced relationship discord observed here among males treated with citalopram may be related to the ‘flattened affect’ which is
reported by patients receiving SSRI treatments (Opbroek et al., 2002; Price et al., 2009).

Serotonin activity may play a particular role in the expression of aggression, as suggested by more naturalistic investigations in primates (Raleigh et al., 1991; Mehrman et al., 1995) and human clinical samples (Brown et al., 1979; Brown and Goodwin, 1986). SSRIs reduce both the negative physiological and psychological consequences of negative social interactions in animals (Berton et al., 1999) and the recognition of angry facial expressions in healthy adults volunteers (Harmer et al., 2006). Furthermore, SSRIs are used clinically in disorders characterized by violent and aggressive outbursts (Hollander and Rosen, 2000). Therefore, reduced ‘turulence’ and ‘bickering’ ratings in the citalopram-treated male participants may reflect diminished conflict-related attributions, potentially improving close inter-personal relationships following antidepressant treatment (Coyne et al., 2002).

Citalopram and judgements about dominance and/or dependence

Finally, male participants treated with citalopram rated male partners in the photographs as significantly more dominant than the female partners, whereas male participants treated with placebo rated male and female partners as roughly equally dominant. This finding resonates with observations linking serotonergic function to the expression of dominant behaviours in animals (Raleigh et al., 1991) and humans (Moskowitz et al., 2001; Tse and Bond, 2002b). Although positive and negative associations between serotonin activity and indices of dominance have been reported (aan het Rot et al., 2006; Riddick et al., 2009), our results complement our previous observations (Bilderbeck et al., 2011) that tryptophan depletion increased female participants’ ratings of male dominance. Together our findings suggest that manipulating serotonergic activity in healthy adults can alter gender-specific attributions of power in relationships in asymmetric ways: judgments of male dominance can be enhanced by reducing serotonin activity in females but by enhancing serotonin availability in males.

Our data also provide novel indications that serotonin is involved in judgments about romantic partners’ relative emotional investment to one another. Following placebo, male and female participants judged the partner of their own gender (in the couples’ photographs) to be more in love than their counterpart. In contrast, male and female participants treated with citalopram rated the partners as equally in love with one another. Imbalance in emotional engagement is often a painful experience, and one which tends to signal problematic power imbalances (Sprecher, 1986). These results suggest that enhanced serotonergic activity is associated with judgments of closer reciprocity in emotional commitment; a state likely to be valued in intimate relationships.

We acknowledge two limitations to this work. First, our investigation involved a broad conception of intimate relationships and their features, necessitating a relatively large number of statistical comparisons between treatment groups. Although the preliminary findings reported here and reported by Bilderbeck et al. (2011) establish that manipulating serotonin activity can influence judgments about multiple aspects of close partnerships, further experimentation will need to focus more closely upon sexual intimacy, dominance and the resolution of conflict and trust as sources of value within relationships. Second, we did not systematically control the ethnic and cultural background of the participants receiving the citalopram treatment and the participants receiving the placebo treatment. Therefore, it is possible that some participants’ ratings reflected uncontrolled cultural factors.

Notwithstanding these caveats, our results support the hypothesis that manipulation of serotonin activity influences cognitions underpinning healthy intimate relationships, including those with current romantic partners. Our data will help to refine hypotheses about how serotonergic disturbance mediates maladaptive social cognitions in clinical populations – and how tasks such as the rCAT can provide insights into aspects of cognition relevant to close intimate relationships.

Conflicts of Interest

Professor Cowen has been a paid member of advisory boards of Eli Lilly, Servier and Wyeth, and has been a paid lecturer for Eli Lilly, Servier, Glaxo Smith Kline, and Lundbeck. Dr. Bilderbeck, Ms. Wakeley, Dr. Godlew ska, Professor McGlone, Dr. Harris and Professor Rogers have no biomedical financial interests or potential conflicts of interests to declare.

REFERENCES


Serotonin & relationship appraisals


