The drive to control : how affect and motivation regulate cognitive control

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Romantic Love and Focused Attention

"There is always some madness in love. But there is also always some reason in madness."

Friedrich Nietzsche

This chapter is based on:

van Steenbergen, H., Langeslag, S.J.E., Band, G.P.H., & Hommel, B. (submitted for publication). Reduced cognitive control in passionate lovers.

Abstract

Passionate love is associated with intense changes in emotion and attention which are thought to play an important role in the early stages of romantic relationship formation. Although passionate love usually involves improved, near-obsessive attention to the beloved, anecdotal evidence has suggested that the lover's concentration for daily tasks like study and work may actually be impaired. We systematically investigated a link between passionate love and cognitive control in a sample of students who had recently become involved in a romantic relationship. Intensity of passionate love as measured by the Passionate Love Scale was shown to predict decreased individual efficiency in cognitive control as measured in Stroop and flanker task performance. This study provides the first systematic empirical evidence that impaired cognitive control is an important characteristic of passionate love.

Introduction

Falling in love is an experience that involves very intense emotional changes including euphoria and overwhelming joy, increased arousal and energy, emotional dependency on the partner, craving for emotional union with the beloved, and obsessional thoughts about and focused attention on the special other (Fisher, 1998). Passionate love has been recorded in all contemporary human cultures for which data are available and it can be traced back to ancient historical and literary sources (Jankowiak & Fischer, 1992). Systematic psychological investigation has shown that this attraction-related emotional state – also referred to as limerence (Tennov, 1979) or infatuation – can be distinguished from lust and attachment, aspects of romantic love that are driven by dissociable affective systems (Fisher, 1998; Hatfield & Sprecher, 1986; Reis & Aron, 2008).

Cumulating neuroscientific evidence has recently led to the formulation of biologically and evolutionarily informed theories that aim to understand why love is so important in human behavior (Fisher, Aron, & Brown, 2006). According to one influential proposal, passionate love originates from an phylogenetically old mechanism that boosts courtship attraction via neurochemical modulation (Beach, 1976; Fisher et al., 2006). Extending earlier evidence from animal studies, neuroimaging studies in humans have shown that the euphoria and near-obsessive attention devoted to the beloved is associated with reward circuitry activation (Bartels & Zeki, 2000) which varies as a function of passionate love intensity (Aron et al., 2005). In line with evolutionary theory, infatuation and the associated, often demanding and wasteful behavior (Miller, 2000) rarely last much longer than until sexual reproduction has been achieved (Tallis, 2005a; Tallis, 2005b).

In the light of these considerations, passionate love might be suspected to deplete cognitive resources needed for the control of goal-directed behavior in everyday life. Effects of that sort have indeed been reported for the processing of high arousing emotional stimuli, which impairs cognitive control by exhausting resources shared with executive functions (Pessoa, 2009). Anecdotal evidence suggests that something similar may hold for passionate love. People who are madly in love may find it more difficult to concentrate on daily tasks like study and work, a feature that passionate love is proposed to share with mental disorders (Tallis, 2005b). However, until now, systematic empirical evidence for a link between passionate love and diminished executive functioning is lacking. We aimed to provide such evidence, if possible, by testing whether the individual efficiency in a standard cognitive-control task can be predicted by the intensity of passionate love exhibited by participants involved in the early stage of a romantic relationship.

This prediction might be tested by comparing performance of infatuated people to a control group of individuals who are not involved in a romantic relationship. However, given that the majority of people in late adolescence have a romantic relationship (Collins, Welsh, & Furman, 2009), this approach would inevitably result in distorted comparisons, e.g., by biasing the control group towards individuals with uncommon traits and inappropriate social skills to engage in relationships (which in itself may be related to altered executive functions; Beauchamp & Anderson, 2010). Moreover, this design would make insufficient use of the fact that individual differences in the intensity of passionate love is likely to account for a substantial part of the variance; indeed, people who are madly in love may show much stronger dysfunction in cognitive control than mildly loving people (cf. Tallis, 2005b).

Given these considerations, we decided to adopt a correlational approach that relates individual differences in infatuation to individual differences in control efficiency. We used the standard Passionate Love Scale (PLS), a questionnaire developed by Hatfield and Sprecher (1986) to quantify passionate love. Cognitive control was measured by versions of two classical conflict-inducing tasks: the flanker task (Eriksen & Eriksen, 1974) and the Stroop task (Stroop, 1992). These two tasks assess the individual ability to attend to relevant information while filtering out distracting, irrelevant spatial and verbal information, respectively. This allowed us to test whether the possible link between passionate love and cognitive control generalizes across tasks or whether it is task-specific. A balanced number of male and female subjects were included to test for generalizability across gender.

Method

Participants

Fifty-one healthy heterosexual students who had recently (at most 6 months ago) fallen in love participated either for payment or course credits. Based on initial screening of the behavioral data, eight participants were excluded from further analyses because of random performance during at least one of the experimental task blocks. The age range of the remaining 43 participants (23 females; 20 males) was 18 – 27 years (mean = 20.9 years), four participants were left-handed. All participants had a relationship with their beloved (mean duration = 2.8 months). The reported duration of being in love ranged between 1 and 6 months (mean = 3.4 months). All participants were Dutch native speakers, not color blind, and without a psychiatric history.

Tasks

Two variants of a classic cognitive control paradigm were used. The flanker task (Eriksen & Eriksen, 1974) consisted of centrally presented target stimuli which were vertically flanked on either side by two identical response-compatible or response-incompatible stimuli. The Stroop task (Stroop, 1992) consisted of a column of five identical stimuli presented in response-compatible or response-incompatible ink colors. Flanker and Stroop stimuli were carefully matched by using two non-overlapping sets of Dutch color words ("brown", "gray", "yellow", and "red" or "purple", "green", "orange", and "blue"). Each task used a counterbalanced unique set of four words. Two targets were mapped to a left hand response, whereas the other two targets were mapped to a right hand response.

E-prime™ software was used for stimulus presentation and response recording. All trials started with a fixation cross (randomly varying intervals of 800, 1000, or 1100 ms), followed by the stimulus, which was presented until response registration or, in the case of omission, for 1500 ms. In half of the trials the stimuli would call for different responses (incompatible condition; e.g., the word "green" surrounded by the words "yellow" in the flanker task and the word "blue" printed in red in the Stroop task) whereas in the other half identical target and distracter dimensions would call for the same response (compatible condition; e.g., the word "green" surrounded by the words "green" in the flanker task and the word "blue" printed in blue in the Stroop task). All trials were presented in an unconstrained random sequence. Stimuli appeared in lower-case in Arial bold font (3.5 cm wide and 5.4 cm high) and were presented on a grey background. Flanker-task stimuli used black ink color. Participants viewed the stimuli on a 17" monitor from about 60 cm.

Procedure

After giving informed consent, subjects received task instructions that emphasized both speed and accuracy. Both the flanker and the Stroop task were practiced in 16 trials that included performance feedback. Participants then filled out a Dutch translation of the PLS (a unidimensional scale that includes 30 items on a 9-points scale; Hatfield & Sprecher, 1986; Langeslag, Jansma, Franken, & Van Strien, 2007) and were instructed to develop a romantic mood by imagining and writing about an appropriate romantic event from their past or to focus on a romantic vignette they were given. During this 10-min period, subjects listened via headphones to their own favorite love-related music which they had brought with them. This procedure is known to evoke intense feelings of romantic love (Mashek, Aron, & Fisher, 2000). Participants then performed a block of 72 trials for each task. After a short, 3-min romantic mood booster (again using imagination and music), another block of each task was presented. The order of tasks was counterbalanced across participants. Participants rated their current mood state using a computerized affect grid (measuring mood valence and arousal; Russell et al., 1989) occasionally provided throughout the experiment.

Results

Correct reaction time (RT) and accuracy measures of interference were calculated for the Stroop and flanker tasks by subtracting average performance on compatible trials from average performance on incompatible trials. Both tasks produced robust RT interference scores (flanker task: 29 ms, $t(42) = 8.17$, $p < .001$; Stroop task: 38 ms, $t(42) = 5.24$, $p < .001$), indicating that they successfully induced decision conflict. These interference scores were submitted to a repeated-measures analysis of covariance (ANCOVA) using the factors Task (within subjects: flanker versus Stroop), Sex (between subjects: female versus male), and PLS-score (between-subjects covariate). As Figure 1 shows, higher PLS-scores were found to be a reliable predictor of interference effect increases ($F(1,39) = 5.18$, $p = .028$, $MSE = 974.54$, partial eta squared = .117), a correlation that was independent of Task ($F(1,39) = 1.252$, $p = .270$, $MSE = 1263.70$, partial eta squared = .031) and Sex ($F(1,39) = .147$, $p = .704$, $MSE = 974.54$, partial eta squared = .004). Main effects of Task and Sex or higher-order interactions were not observed either ($Fs < 1.44$). A predictive effect for PLS-score was not found for interference effects measured in accuracy ($F(1,39) = 0.26$, $p = .611$, $MSE = .004$, partial eta squared = .007), indicating that the RT results could not be accounted for by a speed-accuracy trade off. A separate analysis on overall RT showed that the effect of PLS on attentional interference could not be accounted for by a scaling effect due to RT slowing ($F(1,39) = 1.25$, $p = .270$). We re-ran analyses to ensure that the effects on interference were not exclusively driven by three particular PLS items that explicitly refer to obsessional thoughts and intrusive thinking (i.e., items 5, 19, and 21). A PLS sumscore that did not include these items, was also shown to be a reliable predictor of interference effect increases ($F(1,39) = 5.22$, $p = .028$, $MSE = 972.63$, partial eta squared = .118).

As control analyses, we also tested whether the effect of PLS on interference might have been mediated by mood effects. We analyzed average arousal and valence ratings (9-points scale) across ratings provided just before and after the task blocks. Arousal was positively associated with PLS scores ($r = .326$, $p = .033$), but not with the interference effect ($r = .185$, $p = .235$). Valence was not related to PLS ($r = .019$, $p = .902$) nor to interference ($r = -.134$, $p = .393$). This shows that arousal may share some variance with PLS scores, but that neither mood valence nor arousal played a reliable mediating role in the relation between romantic love and attentional interference.

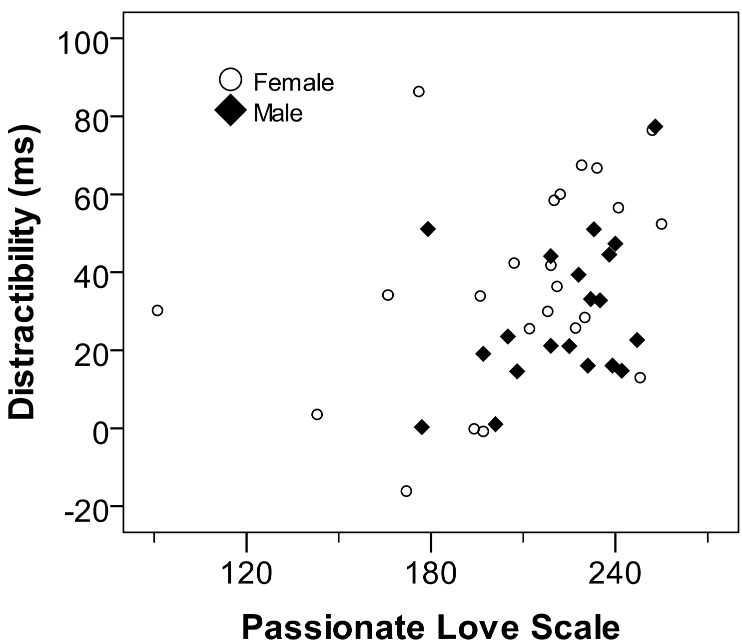

Figure 1. *Positive correlation between Passionate Love Scale scores and distractibility as measured by a composite score of interference effects pooled across the Stroop and flanker tasks.*

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Discussion

This study provides the first evidence to suggest a systematic link between passionate love (as measured by the PLS) and impaired cognitive control (as measured by flanker and Stroop task performance). Passionate love was associated with increased distractibility in a sample of students involved in the early stage of a romantic relationship. This effect did not interact with the specific task employed, suggesting that intense passionate love is associated with a general loss of cognitive control. Furthermore, the link between passionate love and executive control was independent of gender, which implies that the underlying mechanism related to attraction probably does not interact with, or rely on sex-specific systems involved in attachment and sex drive (Fisher, 1998).

This finding is consistent with the assumption that infatuation becomes costly when daily life demands goal-directed behavior and cognitive control (Tallis, 2005b). It might be speculated that such effects are related to love-induced neurochemical effects. Elevated neurotransmitter levels, such as dopamine, have consistently been related to mating preference in animals (Fisher et al., 2006), and a recent study in humans has shown that PLS scores correlate positively with activity in the striatum (Aron et al., 2005). Increases in striatal dopamine are known to deplete prefrontal dopamine (Cools, 2008), which might have caused the impaired cognitive control observed. However, future research is required to corroborate such speculations.

Our study shows that passionate love, notwithstanding the positive feelings it is usually associated with, has negative effects for the goal-directed control of one's behavior. Such downsides of passionate love have long been suspected and anecdotal evidence traces back to ancient times (cf. Tallis, 2005b). We provided the first systematic empirical evidence suggesting that impaired cognitive control is an important characteristic of passionate love. The fact that love distracts people away from conventional civilized behavior motivated Plato even to depict love as a kind of madness, a possibility which psychologists should begin to take more seriously (cf. Tallis, 2005a).

Acknowledgments

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