
Why Love Has Wings and Sex Has Not: How Reminders of Love and Sex Influence Creative and Analytic Thinking

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This article examines cognitive links between romantic love and creativity and between sexual desire and analytic thought based on construal level theory. It suggests that when in love, people typically focus on a long-term perspective, which should enhance holistic thinking and thereby creative thought, whereas when experiencing sexual encounters, they focus on the present and on concrete details enhancing analytic thinking. Because people automatically activate these processing styles when in love or when they experience sex, subtle or even unconscious reminders of love versus sex should suffice to change processing modes. Two studies explicitly or subtly reminded participants of situations of love or sex and found support for this hypothesis.

Keywords: *love; sex; processing styles; priming; construal level*

Are love and sex the same or are they different? Both evolution theory and Freudian thinking propose a close link between love and sexual desire. Whereas evolution theory describes love as an epiphenomenon of reproductive instincts (see Buss, 1996, 2004; Darwin, 1871/2004), the Freudian idea of eros as an overwhelming sexual drive that motivates most of human behavior (Freud, 1905/2000) may similarly subsume love under the roof of sexual instincts. Against the background of these cornerstones of theory building, it seems almost romantic, if one assumes substantial psychological differences between sexual desire and romantic love.

Also in modern times, there is abundant social psychological evidence in support of the contention that in most people's minds, love and sex are tightly related—to the extent that most people find it hard to imagine passionate love absent of sexual desire (Hatfield & Rapson, 2005; Regan & Berscheid, 1995; Regan, Kocan, & Whitlock, 1998). However, this means neither that passionate love and sex are identical nor that this link is fixed in human nature. For starters, the size of this overlap may vary with culture, history, education, and social values (Aries & Dupies, 2000). Here are some examples: In the United States, males report having less problems imagining sex without love than females do (Hatfield & Rapson, 2005); in China, however the link between love and romance seems to be generally less

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pronounced than in Western cultures (Dion & Dion, 1988); and in the West, the views of sexuality and love differed between the Victorian and the Freudian eras (Hatfield & Rapson, in press). Recently, neuroscientists and evolutionary psychologists joined in a heated discussion on whether love and lust are very different systems (Diamond, 2003, 2004; Gonzaga, Turner, Keltner, Campos, & Altemus, 2006) or are tightly linked (Bartels & Zeki, 2000). When the dust settles, however, they seem to agree that all of the brain systems for passionate love, sexual desire, and attachment do in fact communicate and coordinate with one another.

Berscheid and Hatfield's (1969) contention that love and sex are "kissing cousins" in that they are inherently linked in people's minds and brains but are not the same and thus can produce independent psychological effects seems like a wise compromise. However, the question then becomes *when*, *where*, and *how* love and lust produce different psychological effects. We suggest that love and lust lead to different ways of perceiving the world that further influence complex tasks such as creative and analytic thought.

OF FOREST AND TREES

People process information in two fundamentally different ways: They focus on the forest or they focus on the trees. Whereas the former illustrates a holistic or global processing style, the latter reflects a more detail-oriented or local processing style (Navon, 1977; Trope & Liberman, 2003). These ways of perception have been closely linked to creative versus analytic thought: Whereas global processing leads to creative thought, local processing facilitates analytic thinking (see Friedman & Förster, 2008). We reason that when reminded of love, people start thinking globally, whereas when reminded of sex, they start processing the details of objects in the environment. With others, we define romantic love as "feelings of infatuation and emotional bonding that are commonly associated with romantic relationships" and sexual desire as the "wish, need, or drive to seek out sexual objects or to engage in sexual activities" (see Diamond, 2003; Regan & Berscheid, 1995). We suggest that love entails wishes and goals of attachment (Diamond, 2003; Mikulincer, 1998; Mikulincer & Shaver, 2007), including a long-term perspective, whereas lust exists more in the "here and now" and does not necessarily involve a long-term perspective. However, construing events in the distal future has been shown to trigger more global processing than construing events taking place in the proximal future (Liberman & Trope, 1998). Thus, love may trigger global processing whereas sex may trigger local processing. Furthermore, because of the strong

link between global/local processing and creative/analytic thought (Friedman, Fishbach, Förster, & Werth, 2003), we suggest that the processing styles elicited by love versus sex influence such complex phenomena as creative and analytic thinking. Let us elaborate on the building blocks of our model on love triggering distal perspective triggering global processing triggering creative thinking and on sex triggering proximal perspective triggering local processing triggering analytic thinking.

PILLARS OF OUR MODEL

Our model is based on four pillars: (a) cognitive models of love and partner perception, (b) processing shift theory, (c) attentional tuning theory of creativity, and (d) construal level theory. We briefly review each of these pillars.

Cognitive models of love and partner perception suggest that beyond the feeling component, love and sex both have cognitive components (see Neff & Karney, 2002, 2005; Noller, 1996; Rubin, 1970; Sternberg, 1986). They are represented in our mental system and as such are associated with specific exemplars, semantic associations, expectancies, behavioral manifestations, and images. The concept of love involves features such as "long-lasting," "focus on the positive aspects," and "commitment," among others (Aron & Westbay, 1996; Fehr, 1988) and contains abstract ("he is the greatest") as well as more concrete ("he is supportive") knowledge (Andersen & Cyranowski, 1994; Hampson, John, & Goldberg, 1986; John, Hampson, & Goldberg, 1991; Neff & Karney, 2002, 2005; Noller, 1996; Rubin, 1970; Shah, 2003; Sternberg, 1986). Furthermore, being in love fosters a close bond between the representations of self and partner. This not only is found on an emotional level but is also part of one's cognitive representation of one's relationship (Aron, Aron, & Smollan, 1992).

To give an example of some cognitive effects, the connection between the mental representation of self and partner produces *transference* effects in that when interpreting another person's behavior, we often do so by unintentionally taking our partner as a reference point (see Andersen & Chen, 2002, for a review). However, the mental representation of a partner is not necessarily an accurate one. Loved ones are idealized in many ways, sometimes automatically and sometimes strategically (Murray, 1999; Murray & Holmes, 1997). A variety of results indicate a positivity bias toward a partner that is only diminished at critical turning points of a relationship (Gagné & Lydon, 2004). All of these findings indicate that being in love has consequences that are based on cognitive representations, operating beyond an affective level.

Whereas classic memory models usually differentiate between semantic memory and procedural memory (see Tulving & Schacter, 1990; see also Schooler, 2002; Smith, 1989), cognitive models of love have, to the best of our knowledge, not taken advantage of such a distinction and have focused on semantics. We suggest that at the level of procedural knowledge, love versus sex may trigger different content-free processes such as global versus local perception.

Procedural priming and its mechanisms have been described in *processing shift theory*, predicting that cognitive procedures can carry over from one task to subsequent tasks, reflecting “processing shifts” (Schooler, 2002; Schooler, Fiore, & Brandimonte, 1997). *Transfer-appropriate* processing shifts result when the once-activated procedures are beneficial for subsequent processing, whereas *transfer-inappropriate* shifts result when the procedures impair subsequent processing. To illustrate, Friedman et al. (2003) have shown that if people were primed with a global processing style (participants had to look at the gestalt of state maps), they showed better performance in an unrelated subsequent task requiring a holistic processing style such as creative thought. In contrast, for participants who were primed with a local processing style (they had to look at details of the same map), creative performance worsened (see also Förster, Friedman, & Liberman, 2004). In a similar vein, we predict that love elicits a global processing style that can further carry over to creativity tasks, enhancing performance because it is transfer appropriate for these kinds of tasks; a local processing style elicited by sex, however, would be an inappropriate processing style, impeding performance. The reverse should be true for analytic tasks. Why would creative or analytic performance profit or suffer from basic perceptual processing styles?

Attentional tuning theory (Friedman & Förster, 2008) predicts a link between global processing and creative problem solving and local processing and analytic thinking (see, e.g., Finke, 1995; Friedman & Förster, 2005; Schooler & Melcher, 1995; Ward, 1995). From this perspective, a variety of creativity tasks may be readily understood as benefiting from more abstract construals of problem components. For instance, creativity on alternative uses tests (e.g., generating reasons for why to greet somebody) should be enhanced by construing the target object at issue (e.g., greeting) on a higher level of abstraction; thinking of greetings in relatively abstract terms such as a “way to socialize” or a “gesture of communication” might lead to more diverse and original solutions than thinking of it as “waving” or “saying hello.” Whereas the former might lead to solutions that are more remote and diverse from the actual object, the latter might render common associates overaccessible,

impeding innovation (see Marsh, Ward, & Landau, 1999). Research shows that participants who imagined a temporarily distant event before solving a creativity task outperformed those who imagined a temporarily close event (Förster et al., 2004). Inasmuch as love activates a long-term perspective that elicits global thinking, one may predict that love triggers creativity. In contrast, analytic task performance profits from the use of well-learned logical rules that merely have to be remembered and used to solve the problem (Amabile, 1996). According to classic theories (Tucker & Williamson, 1984; see also Derryberry & Reed, 1998; Derryberry & Tucker, 1994; Luu, Tucker, & Derryberry, 1998), analytic thinking profits from narrow or local processing. Thus, a local processing style triggered by thoughts of sex should enhance analytic task performance.

Construal level theory (CLT; Liberman & Trope, 1998, 2008; Trope & Liberman, 2003) suggests that temporal perspective predicts levels of processing. Because usually less is known about distant future events, people start thinking about distal situations in more abstract ways, whereas proximal events are processed in a relatively more concrete manner. As a result of the constant co-occurrence of temporarily distant events and abstractness, people may start thinking in more holistic ways whenever they think about a more distant event, with the reverse being true for more proximal events. Empirical evidence supports this theory (for recent reviews, see Liberman & Trope, 2008; Liberman, Trope, & Stephan, 2007). For example, it has been shown that when asked to think about reading a book a year from now, people construe the event in more abstract terms (e.g., broadening one’s horizon) whereas when they think about doing it tomorrow their thoughts are more concrete (e.g., flipping pages; Liberman & Trope, 1998, Study 1). Romantic love can be considered a state that usually involves a long-term goal or desire of staying together with a person. It involves wishes of long-lasting attachment and “foreverness” (Hazan & Shaver, 1987) and thus contains a perspective on the distant future, which can be remote from concrete aspects. Goals triggered by sexual desire, however, are more specific in nature, involving physical features, specific strategies of seduction, or more concrete scripts of mating behavior and fetishes (e.g., Beck, Bozman, & Qualtrough, 1991). Sexual desire exists in the present and does not necessarily involve a long-term perspective as is reflected in the notions of a “one-night stand.” In a recent study we asked participants to either imagine a walk with a loved person or imagine sex without love and to write down their thoughts. It was shown that participants primed with love imagined events taking place in the more distant future whereas participants primed with sex imagined more temporally

proximal events (Förster, Özelsel, & Epstude, 2009). In line with CLT, we predict that links between global processing and love, and local processing and sex, can evolve through proceduralization. After this brief discussion of the four theoretical pillars on which our model is based, we now review some indirect empirical evidence for our hypothesis.

EMPIRICAL EVIDENCE FOR OUR HYPOTHESIS

Recently, Griskevicius, Cialdini, and Kenrick (2006) provided first evidence for the notion that love can trigger creativity. Adopting an evolutionary perspective (Buss & Barnes, 1986), the authors argue that because humans show a desire for creativity in their romantic partner (Li, Bailey, Kenrick, & Linsenmeier, 2002), creativity is rewarded in most societies and furthermore signals “good genes” (Møller & Petrie, 2002; Zahavi & Zahavi, 1997). Thus, from a functional point of view, reminders of mating behavior may trigger creative thought to enhance mating success. In a study, long-term and short-term mating goals were activated by asking participants to imagine one of the following scenarios: (a) a night on the beach with a romantic partner (short term), (b) an official first date with someone who could become a permanent partner (long term), or (c) a concert with a friend (control group) (Griskevicius et al., 2006, Study 2). For male participants, compared with the control group, creativity increased after imagining the short-term scenarios; this was even more so after imagining the long-term scenario. For females, no effects were obtained. In a different study, when commitment was added to the long-term scenario (i.e., the partner for the first date was described as trustworthy and committed), females showed a significant increase in creative performance. The authors argue that creativity is a tool to receive attention from romantic partners; however, the threshold for displaying creativity is lower for males because they already start getting creative when they imagine short-term dates (Griskevicius et al., 2006, Study 3).

We do not want to argue against this possibility; however, in our studies we want to disentangle love from lust more clearly (and thus deconfound these two aspects with respect to the Griskevicius et al., 2006, studies) to see whether a different mechanism can cause similar results when love (without sex) versus sex (without love) are primed. In our Study 1, we ask participants to imagine sex without being in love. We predict that in situations of mere sex, a local, detail-oriented processing style is elicited that enhances analytic rather than creative thought. In a different experimental condition, we ask participants to imagine love without sex. In this

condition, we aim to replicate the Griskevicius et al. (2006) studies; however, we will be the first to show that only creative thinking but *not* analytic thinking (or any motivation) increases after love priming. We do not expect any differences between the genders because our analysis is less functional and less dependent on (mating) reward structures; rather, it proposes that certain cues trigger certain kinds of cognition. We suggest that such basic processes should be unaffected by gender as long as both males and females think about the distant future while thinking about love and about the here and now when they think about sex.

OVERVIEW OF THE PRESENT RESEARCH

We conducted two studies. In Study 1, we asked participants to either imagine a situation of love or of casual sex and afterward measured creative and analytic thinking. In Study 2, we primed love and sex subliminally to test whether the same effects could be obtained when triggered outside of awareness.

STUDY 1

Method

Participants and design. Sixty students were recruited (31 women, 29 men; average age = 21.30 years) to participate in a battery of unrelated experiments that lasted approximately 2 hr and for which they received 20 euros. The one-factorial design with the factor priming (love vs. sex vs. control) was realized between participants. Note that each cell had 20 participants with a balanced gender distribution. The main dependent measures were a creative insight and an analytic task. Participants could not see each other and experimenter gender had no effects.

Procedure. The current study was introduced as a series of completely unrelated tasks that were combined in one experimental session for economic reasons; materials were presented in different fonts, colors, paper types, and style of instructions to increase the perception of unrelatedness. Upon arrival, participants had to perform a task allegedly assessing their capacity to imagine pleasant emotional events. They were told that if the task would be too emotionally involving or intimate, they could stop at any time. They were asked to take notes. The love-priming group was told to imagine a long walk with their beloved partner and to try to experience how much they loved him or her. Participants with no partner were asked to imagine an ideal partner. The sex-priming group was asked to imagine a situation

of casual sex with a person to whom they were attracted but not in love. The control group was asked to imagine a nice walk on their own. All participants were asked to imagine the pleasure involved in the event and were asked to write down their thoughts.

Afterward, a survey checked difficulty of imagination, embarrassment, liking of the task, and liking of the imagined event on scales from 1 (*not at all*) to 9 (*very much*). A mood questionnaire followed, assessing general mood (“How do you feel right now?”) on a scale from 1 (*very bad*) to 9 (*very good*) and specific emotions (i.e., how “happy,” “worried,” “scared,” “relaxed,” “nervous,” “down,” “disappointed,” “joyful,” “loving,” “calm,” “tense,” “depressed,” “aroused,” and “relieved” they currently felt) on a scale from 1 (*not at all*) to 7 (*extremely*). Next, the creative insight task and the analytic task were administered.

For the *creative insight task* three classic problems were used (Schooler, Ohlsson, & Brooks, 1993, Problems 1-3). This task assesses creative insight inasmuch as it is (a) ultimately soluble, (b) likely to produce an impasse during the solution, and (3) likely to produce an “aha!” experience when the solution is discovered after prolonged efforts. An example for a creative insight problem is:

A dealer in antique coins got an offer to buy a beautiful bronze coin. The coin had an emperor’s head on one side and the date 544 B.C. stamped on the other. The dealer examined the coin, but instead of buying it, he called the police. Why? Solution: The year 544 B.C. predates the birth of Christ, a coin from that year would thus not be inscribed B.C.

Number of problems solved within the given time was our proxy for creative thought. For the *analytic thinking task*, four logic problems from the Graduate Record Examination (GRE) of the form “If $A < B$ and $C > B$ then?” were chosen (as used in Friedman & Förster, 2000). These problems involve evaluating the truth value of a number of propositions given an initial set of basic facts.

Whereas analytic tasks can be solved with conventional tried-and-true ways of problem solving, research shows that creative insight tasks profit from unconventional ways of thinking and new combinations of formerly unrelated associations (Schooler et al., 1993). Moreover, unlike creative thinking tasks, analytical problems involve systematically organizing the given information and carefully analyzing it to determine the verity of a series of logical conclusions.

Participants were given 6 min for the insight and 4 min for the GRE tasks. Number of problems solved served as dependent variables for each thinking style. We also checked for difficulty of task performance to rule out effort as an explanation. Participants were asked to rate the difficulty

they experienced when working on the tasks (“How difficult did you find the creative/analytic tasks?”) on a scale from 1 (*very easy*) to 9 (*very difficult*), their motivation (“How motivated were you to solve the creative/analytic tasks?”) on a scale from 1 (*not at all*) to 9 (*highly motivated*), and the effort they invested (“How much effort did you put into the creative/analytic task?”) on a scale from 1 (*no effort at all*) to 9 (*very much effort*). Next, we asked for participants’ relationship status (with the options: in a committed relationship, freshly in love, single, just dumped, dumped a long time ago). At the end of the entire battery, participants were debriefed and paid. When interviewed, none of them saw any relation between the tasks.

Results and Discussion

Descriptives. Sixty percent of our participants were in a committed relationship, 11% were freshly in love, 26% were single, 11% were just dumped, and 15% were dumped long ago. These percentages did not differ by condition, $F_s < 1$.

Evaluation of imagined scenarios and emotions. Two independent raters evaluated the notes participants had taken when imagining the proposed scenarios with respect to (a) their level of abstractness (interrater reliability; $\alpha = .85$), (b) time perspective (amount of thoughts pointing to the future; $\alpha = .91$), (c) their valence ($\alpha = .79$), (d) whether they contained more promotion focus or prevention focus thoughts ($\alpha = .87$), and (e) whether more actions than states were described ($\alpha = .82$). Please note that all of these variables could be candidates for producing changes in creative or analytic thinking (see Friedman & Förster, 2008). The only difference we found was a difference in time perspective: Participants primed with love reported more wishes, goals, or events that related to future events ($M = 1.70$, $SD = 1.95$) compared to participants primed with sex ($M = 0.10$, $SD = .31$) or those in the control group ($M = 0.85$, $SD = .93$), $F(2, 57) = 8.07$, $p < .001$. Thus, our love manipulation influenced thoughts directed toward the future compared to the other conditions, simple contrasts: love versus control, $t(57) = 2.13$, $p < .04$; love versus sex, $t(57) = 4.01$, $p < .001$; and sex versus control, $t(57) = 1.88$, $p = .065$. We also analyzed the responses on participants’ self-reports, and found no significant differences for experienced difficulty of imagining the event, valence of imagination, liking of task, and embarrassment, all $F_s < 1.6$.

There were only two effects on the self-reported emotions.¹ First, participants felt more in love after they thought about love ($M = 5.85$, $SD = 1.18$) compared to the control group ($M = 4.25$, $SD = 1.77$) or the group that imagined a one-night stand ($M = 4.85$, $SD = 1.46$),

$F(2, 57) = 5.87, p < .005$. Second, sex priming led to higher arousal ($M = 4.65, SD = 1.98$) than love priming ($M = 2.95, SD = 1.10$) or control priming ($M = 2.25, SD = 1.62$), $F(2, 57) = 11.79, p < .0001$.

When asked, 85% of participants in the love condition, 80% in the sex condition, and 90% in the control condition had experienced a similar event before.

Control questions for the creative and analytic task.

To analyze the data, we conducted a 3 (imagination) \times 2 (task) mixed-model ANOVA. We found no significant differences for experienced difficulty, motivation, or effort invested in the tasks, $F_s < 1$.

Task performance. In a 3 (imagination) \times 2 (task) ANOVA, the predicted interaction was significant, $F(2, 57) = 15.45, p < .001$ (see Table 1). The main effect of task was also significant, $F(2, 57) = 69.84, p < .001$, indicating that overall more problems were solved in the analytic ($M = 2.12, SD = 0.98$) than in the creativity ($M = 0.77, SD = 0.81$) task. The main effect of priming was not significant, $F < 1$. *Creative insight* was enhanced for participants primed with love ($M = 1.30, SD = 0.92$) compared to participants in the control condition ($M = 0.75, SD = 0.64$), with the sex-primed group performing the worst ($M = 0.25, SD = 0.44$). All contrasts were significant: love versus sex priming, $t(57) = 4.76, p < .0001$; love priming versus control group, $t(57) = 2.50, p < .016$; and sex priming versus control group, $t(57) = 2.27, p < .027$.

This pattern was the reverse for *analytic thinking*: Participants primed with love performed worse ($M = 1.55, SD = 0.83$) than control participants ($M = 2.10, SD = 0.60$), with the sex-primed group performing the best ($M = 2.70, SD = 1.10$). All contrasts were significant: love versus sex, $t(57) = -4.19, p < .001$; love versus control, $t(57) = -2.00, p < .05$; and sex versus control, $t(57) = -2.19, p < .04$.

Using mediation logic (see Study 2), we entered mood scores separately and jointly as mediators into regression analyses together with the dependent measures. We found no indication for mediation. Thus, it seems that imagining love *directly*—that is, without mood intervening—increased creativity and decreased analytic thinking, whereas imagining sex caused the reverse. We did not find any effects for gender or relationship status when we entered these variables into similar regression analyses.

STUDY 2

To test whether subtle reminders of love versus sex are sufficient to elicit the respective information processing styles, we decided to replicate Study 1 with a subliminal

TABLE 1: Mean Creative and Analytic Task Performance as a Function of Priming in Study 1

Task	Love Priming		Lust Priming		Control	
	M	SD	M	SD	M	SD
Creative insight	1.30	(0.92)	0.25	(0.44)	0.75	(0.64)
Analytic task	1.55	(0.83)	2.70	(1.10)	2.10	(0.60)

priming procedure. A successful replication of the effects found in Study 1 using this methodology would suggest that the phenomenon is largely automatic and is based on the well-known principles of procedural knowledge activation (see Förster & Liberman, 2007) and not so much on conscious deliberations. In addition, we examined whether global versus local perception partially mediated creative or analytic performance by adding a new dependent variable between priming and measurement of creative and analytic thinking (Gaspar & Clore, 2002).

Method

Participants and design. Sixty students were recruited (30 women, 30 men; average age = 23.40 years) under the same conditions as in Study 2. Experimenter gender had no effects.

Procedure. A *subliminal priming* task replaced the imagination task (Chartrand & Bargh, 1996; see Mussweiler & Förster, 2000). Under the pretext of an attention task, participants were primed with either “love,” “loving,” “to love” in the love priming condition or “sex,” “eroticism,” “sexuality” in the sex priming condition, or with a nonword letter string “XQFBZ” in the control condition. Participants were told that brief flashes would appear on the screens at unpredictable places and times and that they had to indicate as quickly and accurately as possible whether the flash appeared on the right or the left side of the screen by pressing designated keys.

Our priming procedure closely followed the one employed by Chartrand and Bargh (1996), including all suggested precautions for preventing conscious awareness of the priming stimuli, such as very brief presentation of the primes, immediate masking, and placement of stimulus content in the parafoveal processing area. In more detail, participants were instructed to focus their gaze on the middle of the screen. At a randomly determined time (varying from 2 s to 7 s) during the trial, a prime word flashed for 70 ms, immediately followed by an 80-ms mask in the same location. The central pattern mask employed was a nonword letter string (“XDNDKHTSKN”). The stimulus word and mask

appeared at one of four locations on the computer screen equidistant from the fixation point at 45°, 135°, 225°, and 315° angles (one in each of the four quadrants). Within a particular location, each word was placed so that the center of the word was 5.5 cm from the fixation point, situating the prime in the participant's parafoveal field, which also ensured that participants were highly unlikely to consciously process it. The study was conducted on flat screens of the model 17 TFF, 1280 × 1024 pixel, at a refresh rate of 60 Hz; previous research in our laboratories showed that the presentation length of 70 ms was adequate to ensure that the stimulus words and masks were always exposed to the participants but were too brief to be consciously recognized; hence, they were unlikely to evoke deliberative or controlled processes. When asked, none of our participants saw any word on the screen. All participants completed 48 experimental trials, which took approximately 2 min.

After priming, the same mood questionnaire as in Study 1 was administered followed by the *global/local task* (Figure 1), which was introduced as an alleged visual matching task (see Gasper, 2004; Gasper & Clore, 2002). Participants had to decide as quickly as possible by pressing one of two designated keys whether a target figure looked like one of the sample figures presented. The target was a compound geometrical figure (e.g., a square) made of different-shaped smaller geometrical figures (e.g., triangles); the sample figures, however, were compound geometrical figures made of same-shaped smaller geometrical figures (e.g., Sample 1 was a triangle made of triangles, and Sample 2 was a square made of squares). Size of targets and sample figures as well as the number of small figures that constituted the large ones varied over trials. Our dependent measure for global processing was the number of global choices participants made (in the preceding example, Sample 2 would count as a global choice whereas Sample 1 would count as a local choice). All participants completed 48 experimental trials.

Next, the GRE task (see Study 1) and a creative generation task were handed out. Given that there is more controversy regarding how to assess creative thinking compared to analytical thinking, we decided to use a different creativity task in this study to test the generalizability of our effects. In this creativity task, participants had 2 min to generate as many uses for a brick as possible; they were to come up with uses that were neither typical nor virtually impossible (as used in Friedman & Förster, 2000). Two independent scorers were asked to separately rate the creativity of the brick uses ("How creative is this response?"); responses ranged from 1 (*not at all creative*) to 9 (*very creative*). These ratings (interrater reliability: $\alpha = .82$) were used to compute

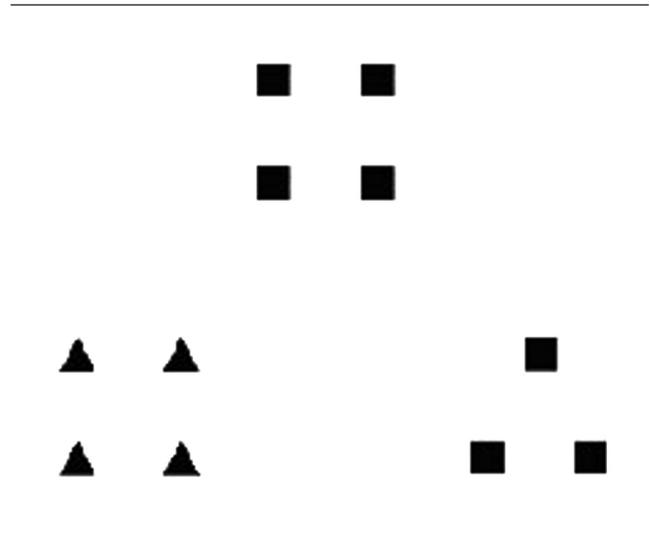


Figure 1 Task, assessing relative global processing.

NOTE: Participants indicated whether the target figure more closely resembles the left or the right sample. In this example, choice of the left sample indicates global processing, whereas choice of the right sample indicates local processing. Forty-eight trials were given and number of global choices were counted as relative global processing.

originality scores for each participant, which were then averaged per condition.

Upon completion, we checked for expended effort, motivation, experienced difficulty of the tasks, and relationship status as in Study 1. Afterward, thorough debriefing took place. None of the participants noticed any relation among the alleged studies, nor did anybody notice that the priming task contained words.

Results and Discussion

Descriptives and mood. Seventy-seven percent of the participants were in a committed relationship, 10% were freshly in love, 12% were single, 5% had recently experienced dissolution of their relationship, and 7% were dumped long ago. These percentages did not differ by condition, $F_s < 1$. There were no significant results on mood scales or task evaluations, all $F_s < 1$.

Global processing. To analyze the data of the *global/local processing task* we conducted a three-way (priming: love vs. sex vs. control) ANOVA. Participants were more likely to prefer the global figures over the local ones after having been primed with love ($M = 40.10$, $SD = 9.61$), followed by the control condition ($M = 33.40$, $SD = 8.58$) and the sex priming condition ($M = 26.30$, $SD = 8.87$), $F(2, 57) = 11.68$, $p < .0001$. All contrasts were significant: love versus sex, $t(57) = -4.83$, $p < .0001$; sex versus control, $t(57) = -2.49$, $p < .016$; and love versus control, $t(57) = -2.35$; $p < .022$.

TABLE 2: Mean Creative and Analytic Task Performance as a Function of Priming in Study 2

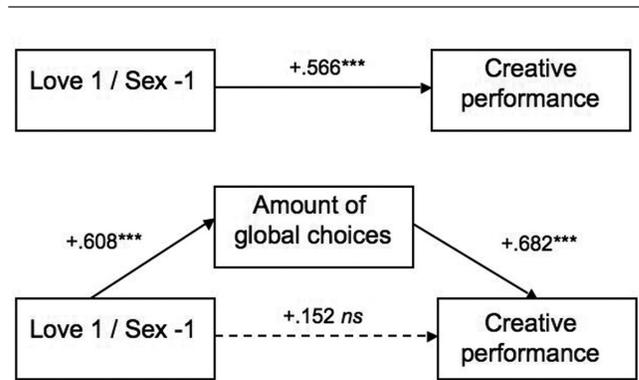
Task	Love Priming		Lust Priming		Control	
	M	SD	M	SD	M	SD
Creative generation	4.98	(0.90)	3.59	(1.21)	4.23	(0.75)
Analytic task	0.80	(1.06)	2.25	(1.25)	1.50	(0.95)

Control questions for the creative and analytic task. As in Study 1, we found no significant differences for difficulty, motivation, or effort invested in the tasks, $F_s < 1$.

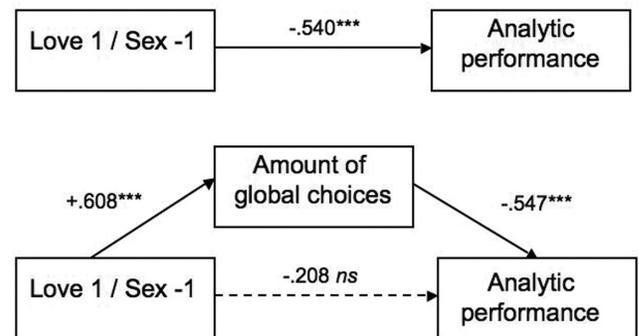
Task performance. Next, we analyzed the creative versus analytic task performance data using a 3 (priming) \times 2 (task) mixed-model ANOVA, with task type as a within-subject factor (see Table 2). The predicted interaction was highly significant, $F(2, 57) = 15.71$, $p < .0001$. There was also a main effect of task, $F(2, 57) = 171.85$, $p < .0001$, and no main effect of priming, $F < 1$.² We found overall higher *creative solution scores* when participants were primed with love ($M = 4.98$, $SD = 0.90$) compared to the control group ($M = 4.23$, $SD = 0.75$) and the sex priming group ($M = 3.59$, $SD = 1.21$). All contrasts were significant: sex versus love, $t(57) = -4.63$, $p < .0001$; love versus control, $t(57) = -2.44$, $p < .018$; and sex versus control, $t(57) = -2.20$, $p < .032$.

For *analytic task performance*, love-primed participants performed worse ($M = 0.80$, $SD = 1.06$) than control participants ($M = 1.50$, $SD = 0.95$), with the sex-primed group performing best ($M = 2.25$, $SD = 1.25$). All contrasts were significant: love versus sex, $t(57) = 4.20$, $p < .0001$; love versus control, $t(57) = 2.03$, $p < .05$; and sex versus control, $t(57) = 2.17$, $p < .04$.

Finally, we examined whether the relative global versus local processing style elicited by love versus sex mediated creative and analytic task performance (Figures 2 and 3) following recommendations of mediation analysis methodology (Kenny, Kashy, & Bolger, 1998). In this analysis, we entered only the experimental groups because the nature of the mediation in the control group was not clear. This variable (love coded as +1 and sex coded -1) and proportion of global choices were entered jointly in addition to the respective dependent variables. A first regression analysis showed that love versus sex was positively correlated with creative performance, $\beta = .566$, $t(38) = 4.23$, $p < .0001$, and negatively correlated with analytic performance, $\beta = -.540$, $t(38) = -3.96$, $p < .0001$. A second regression analysis showed that the higher the relative global processing was, the worse was the performance on the analytic task, $\beta = -.524$, $t(58) = -4.69$, $p < .0001$,

**Figure 2** Mediation of processing style on creative performance (Study 2).

NOTE: Love was coded as +1 and sex as -1. The more love, the higher the amount of global choices, reflecting global processing. The higher global processing, the higher creative task performance. *** $p < .001$.

**Figure 3** Mediation of processing style on analytic performance (Study 2).

NOTE: Love was coded as +1 and sex as -1. The more love, the higher the amount of global choices, reflecting global processing. The higher global processing, the lower analytic task performance. ** $p < .01$. *** $p < .001$.

and the better was the performance on creative generation, $\beta = .685$, $t(58) = 7.16$, $p < .0001$. Most importantly, the effect of global processing was still significant for both analytic performance, $\beta = -.547$, $t(37) = -3.67$, $p = .001$, and creative thinking, $\beta = .682$, $t(37) = 5.30$, $p < .001$. The influence of love versus sex priming, however, was reduced for the analytic, $\beta = -.208$, $t(37) = -1.39$, $p = .172$, and the creative, $\beta = .152$, $t(37) = 1.18$, $p = .246$, dependent measure (analytic task, $Z = 2.67$, $p < .001$; creative task, $Z = 3.32$, $p < .0001$). One can conclude that unconscious reminders of love enhance relative global processing, thus facilitating creative thinking,

whereas unconscious reminders of sex enhance local processing, thereby facilitating analytic thinking. Using a similar logic, we found no effects of moods, gender, or relationship status (subsequently or jointly entered) as mediators for effects on performance.

GENERAL DISCUSSION

Two studies support the notion that love enhances global processing and creative thinking whereas sex enhances local processing and analytic thinking. Thus, contrary to the intuitive notion of creativity and analytic thought as fixed human capacities or stable personality traits, they can easily be changed by subtle cues in the environment or by mere thinking about certain situations (Amabile, 1996). In the following we discuss commonalities and differences with recent research and discuss the compatibility of our findings with respect to evolutionary explanations. Next, we discuss some alternative mechanisms that could have produced our effects. We then point to some consequences of our research for CLT and the related field of counterfactual mind-sets. Finally, we point to some interesting questions for future research.

Commonalities and Differences With the Study by Griskevicius et al. (2006)

Our results are mostly in line with the study by Griskevicius et al. (2006). Both research projects show that long-term goals related to love enhance creative thoughts. However, we extend this line of research by showing that perceptual processing styles elicited by love mediate such processes. We were able to show that participants primed with love attend to the global features of a stimulus set and that this further increases creative thought. Furthermore, we found evidence for the assumption that sex priming undermines creative thought and triggers local processing, supporting analytic problem solving.

There are also important differences between our and Griskevicius et al.'s (2006) studies. First, it seems that in our Study 1 participants were actually mentally simulating a situation of sex *without* love, as is reflected in higher arousal and lower love self-reports after sex priming.³ In Griskevicius et al.'s studies, the scenarios left more room for imaginations confounding sex and love than our instructions. To illustrate, in their studies, the sexual (short-term) scenario handed out to participants ended with two protagonists passionately kissing at a moonlit beach. It is possible that some people simply did not imagine sex. It is also possible that some

participants thought about sex but in addition imagined a possible future that went beyond a one-night stand. Note that in Griskevicius et al.'s studies no effects of scenarios on arousal level were found.

Furthermore, the concept *sex* primed in our Study 2 may have been less distracting from sex thoughts than information offered in different scenarios or activated by free imagination instructions. Thus, whereas participants in Griskevicius et al.'s (2006) experiments could have imagined kissing on the beach, kissing and having sex on the beach, kissing and thinking about the future, and so on, our studies may have more directly primed sex without love and love without sex. Furthermore, it is possible that the instruction to imagine a beach scenario produced a distance to the "here and now" of the participants that in itself creates more global processing (see Liberman & Trope, 1998). In our studies that pitted analytic thinking more thoroughly against creative thinking, we could show that motivation to work on tasks does not generally increase thinking of sex or love. Rather, two qualitatively different processing styles were elicited, leading to different ways of perceiving the world.

Compatibility With Evolutionary Models

In general, we are not opposed to evolutionary factors that may underlie our effects. After all, increasing analytic performance when thinking of sex could be equally impressive for mating partners and could reflect "good genes," such as showing one's creative abilities. There may even be advantages of analytic thinking over creativity. Usually, analytic thinking is the more conventional way of thinking (Amabile, 1996), leading to good conventional products; such a way of thinking may reflect security and stability, whereas any creative solution carries the risk that any novel idea involves (see Förster et al., 2004). Thus, we see no reason for creative thinking being more attractive or desirable than analytic thinking. People of both genders may simply appreciate resourceful partners.

Possible Alternative Explanations: Mood and Regulatory Focus

Recently, Gasper and Clore (2002) demonstrated a strong relation between positive mood and global processing. Inasmuch as both love and sex are positive experiences, one might expect both concepts to elicit similar perceptual consequences as positive mood. Still, we found very different effects for love and sex on perceptual styles. The fact that mood did not mediate any of our results might point to strong associations between the two concepts and the respective processing styles. Thus, our results produced effects on processing styles

independently from moods. This is less surprising if one acknowledges that processing styles can be triggered by all kinds of variables that are independent of affect. For example, global processing has been shown to be associated with psychological distance (Liberman et al., 2007), creative thought (Friedman et al. 2003), a promotion focus on ideals (Förster, Liberman, & Higgins, 2005), interdependent selves (Kühnen & Oyserman, 2002), or right hemispheric activation (Derryberry & Tucker, 1994). However, it might be that sex in some individuals may cause anxiety or worry, and thus mediation of local processing by negative moods may occur in such cases. In our sample, however, it seems participants enjoyed (thinking of) sex.

Another possibility is that love produced different regulatory foci (Higgins, 1997), which have been shown to influence creative thinking as well. Friedman and Förster's (2001, 2002, 2005 ; Förster, Friedman, Özsel, & Denzler, 2006) work showed that a promotion focus on gains and nongains increases creative thought, whereas a prevention focus on losses and nonlosses increases analytic thinking independent from moods. We cannot rule out this possibility in Study 2; however, in Study 1 where independent raters analyzed the stories written by the participants, we found no evidence for an elicitation of regulatory focus. It seems reasonable to assume that both motivational and cognitive factors can trigger basic ways of perception independently.

Counterfactual Mind-Sets

Interestingly, creative task performance and a global processing style has recently been connected to an additive counterfactual mind-set ("If only I owned an umbrella, I would not have gotten wet"), whereas analytical performance and a local processing style has been related to a subtractive counterfactual mind-set ("If only it hadn't rained today, I would not have gotten wet"; Markman, Lindberg, Kray, & Galinsky, 2007). It would be interesting to explore in future research whether sex leads to more subtractive counterfactuals ("If only I would not have flirted with him") *because* people naturally think about sex as taking place in the here and now, starting analytic thought and local processing. On the other hand, it is possible that when in love, people start fewer subtractive counterfactuals but more additive ones ("If only I would have said to him how much he means to me"). These counterfactuals could further influence behavior in that when in love, people would start more approach behaviors based on regret that they "have not done enough," whereas when experiencing sex, they start more avoidance behaviors based on regret that they "should not have done" a certain activity (Roese et al., 2006).

Notably, cognitive and motivational concepts share multiple links with each other. A promotion focus increases global attention, whereas a prevention focus increases local attention (Förster et al., 2005). Additive counterfactual thoughts are connected to promotion focus, whereas subtractive counterfactual thoughts are connected to prevention focus (Roese, Hur, & Pennington, 1999; see also Epstude & Roese, 2008, for a discussion of this link). These diverse links raise the question of whether the present results can be interpreted as simple processing style effects. Alternatively, reminders of love versus sex might elicit shifts in motivational orientation or may even have triggered more conscious or active thought involved in counterfactual thinking or feeling regret.

Again, we did not find any evidence for regulatory focus in Study 1; however, in Study 2, automatic motivational effects cannot be ruled out. This being said, Study 2 used a very subtle procedure that is less likely to activate complex cognitive processes usually involved in counterfactual thoughts and regret. As a consequence, we think our effects are more mechanistic and cognitive in nature. People may habituate certain ways of thinking whenever they are in certain situations. Future research is needed to clarify this point in more detail and to further examine the link between lust and love and counterfactual mind-sets. Specifically the likelihood of mutual activation of the different concepts and how they interact needs to be addressed in research and theory.

Relevance for CLT

Our data are also news for CLT, showing that emotional states can differ in temporal perspective as was discussed by Liberman et al. (2007). One may apply this logic to other emotions. To illustrate, happiness may be an emotion that is more short-lived than, for example, contentment. It is then also interesting what drives the effects. Liberman et al. argue that some emotions may be less direct than others with regard to their psychological perspective. For example, socially defined emotions such as pride or guilt are more distanced from direct experience than fear or happiness, which do not necessarily have a social perspective. Our data may imply that subjective theories or expectations of duration of emotional states may matter as well. It would, for example, be interesting to see whether people who believe that love does not hold forever show less global processing than those that have the romantic ideal of everlasting love. However, it may also be that in certain cultures, *wishes* of foreverness are activated even in people who are more skeptical about stable relationships. One may speculate that love and sex trigger dreams, wishes, or fantasies about distal versus proximal states instead of actual

experiences. Love may trigger wishes of long-lasting attachment, whereas sex may activate the wish to do it “right now,” and from this perspective, the lack of differences based on relationship status and gender in our studies is less surprising. Whether wishes, actual expectancies, or subjective theories drive our effects is still an open question for future research.

Outlook and Suggestions for Future Research

Even though our data suggest independence of love and sex on a cognitive level, we do not think that the concepts could not overlap in certain individuals. Rather, the link between lust and love may be stronger or weaker, depending on experiences, culture, personality, or other relevant variables. Notably, at our level of analysis it seems that friendship and love share similarities because the concept of friendship also includes wishes of foreverness (see also Diamond, 2003). Further research may replicate our findings with friendship primes. Change in processing styles may influence human relationships as well—and may in this case even be functional, as overlooking the details when in love may help overcome daily hassles. The focus on details in sexual situations, however, may prevent people from acknowledging the complex personality of their partners. We recently collected data showing that thinking of a loved partner enhances global processing and further leads to pronounced halo effects (less differentiation of partner qualities), whereas local processing triggered by sex priming reduced it (Förster et al., 2009). It might also be that planning the future affords more creative thought than dealing with problems or situations in the “here and now” because the present situation may be more certain and comprehensible than the future. It is further possible that partners value an analytic, detail-focused thinker when working in the “here and now,” whereas they prefer a creative thinker for creating a future life together. Thus, to reiterate, our data are not at odds with functional or evolutionary models of love, sex, and processing styles; rather, the functions they serve may be slightly different. Future research may examine such exciting functionalities.

NOTES

1. One may wonder whether these high percentages are due to our young college student sample. However, in a different experiment (Förster, Özsel, & Epstude, 2009), in which we used an elderly sample from the same region, even higher numbers were obtained (93% sex without love; 100% love without sex), reflecting the fact that the independence of sex and love is not just a matter of a specific generation.

2. Both studies were repeated using z -transformed scores, and again highly significant interactions were found: Study 1, $F(2, 57) = 15.75, p < .0001$, and Study 2, $F(2, 57) = 21.94, p < .0001$.

3. Close inspection of the stories revealed that none of the participants wrote about love when imagining sex and none thought about sex when asked to imagine love.

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