Peacocks, Picasso, and Parental Investment: The Effects of Romantic Motives on Creativity

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Four experiments explored the effects of mating motivation on creativity. Even without other incentives to be creative, romantic motives enhanced creativity on subjective and objective measures. For men, any cue designed to activate a short-term or a long-term mating goal increased creative displays; however, women displayed more creativity only when primed to attract a high-quality long-term mate. These creative boosts were unrelated to increased effort on creative tasks or to changes in mood or arousal. Furthermore, results were unaffected by the application of monetary incentives for creativity. These findings align with the view that creative displays in both sexes may be linked to sexual selection, qualified by unique exigencies of human parental investment.

Keywords: creativity, sexual selection, parental investment, self-presentation, mating goals

> "In order to create there must be a dynamic force—and what force is more potent than love?"
>
> —Igor Stravinsky

The *Guinness Book of World Records* lists Pablo Picasso as the most prolific artist in history with an astounding 147,800 works of art. Picasso's career is often depicted as a tortuous series of profoundly inspired artistic periods—blue, rose, cubist, surrealist—in which his subjects underwent extravagant visual transformations at the hands of a creative genius performing at the apogee of his ability. But a closer look at Picasso's generative periods reveals an intriguing constant: Each new epoch blossoms with paintings of a new woman—not a sitter or a model, but a mistress—each of whom is touted to have served Picasso as an incandescent, albeit temporary, muse (Crespelle, 1969; MacGregor-Hastie, 1988). Picasso's artistic history, however, is not unique: Creative juggernauts such as Salvador Dalí, Friedrich Nietzsche, and Dante were also acutely inspired by their own muses (Prose, 2002). The enigmatic notion of a muse is rooted in Greek mythology, in which nine godly muses traversed the land, stirring the creative spirits of mortal artists and scientists. And according to historian Francine Prose (2002), all muses share one striking and inextricable feature: Muses—both in history and in mythology—are universally female. Yet if "there is no biological reason why a man can't provide the elements of inspiration" (p. 9, Prose, 2002), how could it be that the elixir of inspiration seems to be primarily concocted by women and predominantly imbibed by men?

The current research presents an evolutionary cognitive framework designed to shed light on the mystery of the muses and also to explain and predict a wider range of behavioral phenomena. This framework is grounded in two underlying premises: First, that a number of human mental traits—including the capacity for and display of creativity—may in part be linked to evolutionary processes of sexual selection and differential parental investment (Miller, 1999, 2000; Trivers, 1972); and second, that evolutionarily relevant contextual cues can serve to activate goals (e.g., the goal to attract a mate) that facilitate behaviors historically associated with success for the attainment of such goals (e.g., Maner et al., 2005; Roney, 2003; Wilson & Daly, 2004). From this foundation, four experiments examine whether cues designed to temporarily activate a goal to attract a mate can increase people's creativity. Drawing on the theory of differential parental investment, the research also explores which specific cues might stimulate a creative boost for men versus women. Finally, the studies gather evidence regarding the nature of the psychological mechanism that may underlie how mating motives serve to foster creativity.

Natural and Sexual Selection of Creative Displays

The construct of creativity is composed of multiple dimensions that share a common thread: Creativity is the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful, valuable; Sternberg & Lubart, 1999). Although classical creativity research has not been concerned with the ultimate origins of human creativity (e.g., see Simonton, 2000), those who

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have offered evolutionary explanations have generally presumed that creative abilities evolved because they somehow enhanced the likelihood of our ancestors' survival without adding unnecessary metabolic costs (e.g., Byrne, 1995; Gibson & Ingold, 1993; Kingdon, 1993). For example, a creative way to spear a fish or build a hut could have enhanced survival for their creator and his or her kin. Other evolutionary theorists have speculated that creative capacities may be a byproduct of various perceptual and cognitive mechanisms (e.g., Pinker, 1997). However, Miller (2000; Haselton & Miller, in press) has recently argued that such explanations are inadequate for several reasons. For instance, not only have other large-brained animals not evolved similar capacities, but many human displays of creativity are highly valued socially yet are difficult to explain in terms of survival value. For example, a farmer produces more tangible survival benefits in a week than a team of musicians, poets, and sculptors will produce in a lifetime. Yet a provocative melody, poem, or sculpture is likely to elicit greater appreciation than an absolutely perfect melon, potato, or zucchini.

Instead of producing direct survival benefits, Miller (2000) and others have proposed that several human mental traits, including creativity, are likely to have at least in part evolved via sexual selection (e.g., Eysenck, 1995; Kanazawa, 2000). Unlike natural selection, whereby traits evolve solely because they enhance the probability of an individual's survival, Darwin (1871) suggested that some traits, such as the elaborate plumage of peacocks, evolve via sexual selection—they evolve because they enhance an individual's ability to attract a mate, which may or may not be independent of whether the trait enhances survival (see Andersson, 1994).

Supporting this viewpoint, human creativity has several features in common with sexually selected traits across different species. Just as members of various species prefer partners with prominent sexually selected traits, such as brilliant tails, humans show a desire for creativity in a romantic partner (Buss & Barnes, 1986; Li, Bailey, Kenrick, & Linsenmeier, 2002). Sexually selected traits across species also tend to function as markers of "good genes" (Møller & Petrie, 2002; Zahavi & Zahavi, 1997). Correspondingly, Haselton and Miller (in press) have found suggestive empirical evidence indicating that creativity may partly serve a similar good genes function in humans.[1] Moreover, because one of the distinct markers of sexually selected traits across species is the conspicuous display of such traits in courtship (Andersson, 1994), the current research explores the extent to which people may be more likely to display creativity when they are primed with cues related to courtship.

Cueing Creativity Through Mating Motivation

Mental mechanisms that evolved to solve specific adaptive problems are often highly sensitive to ecological cues indicating a particular adaptive problem or opportunity, such as a potential threat or mating opportunity (Cosmides & Tooby, 1992; Öhman & Mineka, 2001; Schaller, Faulkner, Park, Neuberg, & Kenrick, 2004; Todd & Gigerenzer, 2000). Moreover, much research has shown that various cues can automatically activate certain goal and need states (Chartrand & Bargh, 1996; Schaller, 2003), and that such states can influence perception and behavior without explicit conscious awareness (Bargh, 1990; Bargh & Chartrand, 1999).

Given the central role of reproduction in evolutionary processes, a functional perspective suggests that mating goals are likely to be closely linked to adaptive outcomes (Bugental, 2000; Kenrick, Li, & Butner, 2003). Cues related to mating can serve to both activate a mating goal and its affective responses (Scott, 1980) and trigger specific mating-related cognitive mechanisms (Gutierres, Kenrick, & Partch, 1999; Haselton & Buss, 2000; Kenrick, Sadalla, & Keefe, 1998). Furthermore, mating-related motives appear to facilitate particular perceptions, cognitions, and behaviors associated with reproductive success (Griskevicius, Goldstein, Mortensen, Cialdini, & Kenrick, in press; Maner et al., 2005; Roney, 2003). If displays of creativity have evolved in part because of their benefit in courtship, cues designed to activate mating motives may also trigger displays of creativity.

Courtship Displays and Parental Investment

But should mating motives produce creative displays in both sexes? Across most species—and in 95%–97% of all mammals—it is exclusively males who display sexually selected traits during courtship (Cronin, 1993). This sex-differentiated pattern is consistent with the notion of predominantly female muses eliciting creative courtship displays in male artists (Prose, 2002). Given this evidence, it is reasonable to hypothesize that mating cues should elicit creativity only for males—the *male-only creative display hypothesis*.

However, it is also plausible that mating cues could stimulate creative displays for both men and women. Sex differences in mammalian sexually selected traits are primarily linked to a species' levels of maternal and paternal parental investment—the time and energy devoted to producing viable offspring (Trivers, 1972). In those species in which courtship displays are an exclusively male sport, such as peacocks, males tend to invest the absolute minimum in offspring—sperm. However, in some species these sex roles are reversed such that the males contribute the majority of parental investment (e.g., Mormon cricket, pipefish seahorse, Panamanian poison arrow frog). Consequently, in such species it is the females and not the males who display their elaborate sexually selected traits in courtship (Andersson, 1994; Buss, 2005).

Humans are somewhat different from most mammals in that both men and women tend to contribute significant parental investment to their offspring (Geary, 2000). Thus, it is reasonable to predict that courtship might stimulate creative displays for both men and women. Consistent with this reasoning are findings that men and women express relatively equal preferences for creativity in a mate (Li et al., 2002). Thus, a consideration of the particulars of human parental investment suggests the alternative hypothesis that mating cues will elicit creativity for both men and women—the *unisex creative display hypothesis*.

Study 1

The initial experiment tested whether priming people with cues related to mating would cause an increase in their creative displays relative to people primed with neutral cues unrelated to mating. To

[1] More specifically, Haselton & Miller (in press) found that ovulating women tend to unconsciously shift their preferences toward preferring creativity-related traits compared with other desirable "good dad" traits in potential sex partners.

test this idea, we used photographs of desirable and available targets to prime mating. Qualitative differences in people's displays of creativity were assessed via ratings of short stories written by participants in each condition. Comparative cross-species findings, data on human mate preferences, and parental investment theory lent themselves to two competing hypotheses: the male-only creative display hypothesis (that a mating prime will elicit creativity only for males) and the unisex creative display hypothesis (that a mating prime will increase creative displays by both men and women).

Method

Participants

Ninety-one participants (*P*s; 35 men and 56 women) were recruited from introductory psychology classes as partial fulfillment of their class requirement. All *P*s came to the lab in groups of 2 to 6 and were each seated between partitions at a computer. The mean age for women was 19.2 ($SD = 1.7$), and the mean age for men was 19.7 ($SD = 2.1$).

Design and Procedure

The overall design of the experiment was a between-participants 2 (*P* sex) $\times$ 2 (Prime: mating vs. control) design. At the beginning of the study, all *P*s wrote two short stories that were used to assess their dispositional creative ability and their general motivation to display it. After the first two writing tasks, half of the participants were primed with cues related to mating. Following the prime, all *P*s wrote an additional two stories that were later rated for their levels of creativity. These ratings served as the main dependent measure in the study.

Creativity tasks. Although there are multiple psychological measures designed to evaluate various forms of creativity (see Kerr & Gagliardi, 2004), these measures are generally not designed to allow participants to display creativity in ways akin to a courtship situation. To allow *P*s the freedom to display their creativity in multiple ways—to allow them to produce something that could be perceived as both novel and appropriate—we developed a methodology in which *P*s were asked to write a short story about an ambiguous image. *P*s viewed and wrote stories about two types of images: cartoon drawings and abstract paintings. Each of the cartoon drawings showed a pair of individuals in an ambiguous situation (in a prison cell and in a café), and both abstract paintings were composed of multiple abstract colorful shapes. Each image was sequentially presented on a computer screen, and *P*s were asked "What do you think is happening in this image?" All *P*s had up to 5 min to write a story for each image, although if they finished earlier they could advance to the next part of the study.

Because there is considerable variation in people's creative abilities, a baseline level was established for each person. Thus, each *P* saw and wrote about two of the four ambiguous images (one cartoon and one painting) before the prime manipulation, and they wrote about the two other images (the counterpart cartoon and the counterpart painting) after the prime manipulation. The premanipulation stories served as a baseline measure of each *P*'s creative ability; the postmanipulation stories served as the main dependent measures. The order of the two types of images that *P*s saw was always the same: The cartoon drawing was first and the abstract painting was second both before and after the manipulation. However, the order of which version of the cartoon and painting that *P*s saw was counterbalanced, and a *P* never saw the same image twice. Thus, the sequence of the study for all *P*s was: Cartoon A (or B), Painting A (or B), prime manipulation, Cartoon B (or A), and Painting B (or A).

Mating prime. After establishing a baseline level of creativity, half of the participants were primed with mating cues similar to those that have been successfully used to activate mating goals in similar procedures (Roney, 2003; Wilson & Daly, 2004). To induce a romantic mindset, *P*s viewed an array of six total photos of three attractive opposite-sex individuals—two photos of each person. (The photos were collected from Match.com—a dating website—and were prerated by students as being highly attractive). All *P*s were then asked to select one person from the array whom they thought was the most desirable romantic partner. After making their selection, the photo of the selected person remained on the screen, and *P*s were asked to imagine that they were preparing to go on a first date with this individual. In an effort to make the mating prime more powerful, *P*s were asked to write about their idea of the perfect first date with this person. All *P*s had up to 3 min to write their descriptions, although if they finished before time was up they had the option of advancing to the next part of the study.

Control participants underwent a similar procedure devoid of any romantic connotations. They saw a photo of a street with several buildings and were asked to imagine being on that street. They were then given up to 3 min to write about their idea of the most pleasant weather conditions in which to walk around and look at the buildings.

Priming booster shots. After the prime manipulation, all *P*s wrote a story about one of the cartoon images. Before going on to write the fourth and last story (about the abstract painting), all *P*s underwent a prime "booster shot" to ensure that they were still in a romantic or a control frame of mind. The booster shots were procedurally identical to the original prime manipulations except that they consisted of a different array of photos of attractive individuals and a photo of another building.

Creativity measures. All four stories written by each *P* were rated for creativity by four student judges (two men and two women) who were blind to experimental conditions. The judges were not experts on creativity; instead, they were fellow students intended to resemble the type of person who might find him or herself on a date with one of the participants. The judges rated each story on eight attributes: the extent to which they thought the story was creative, original, clever, imaginative, captivating, funny, entertaining, and charming. Each attribute was rated on a 1 (*not at all*) to 9 (*very*) scale. Before beginning the rating process, judges read a selection of the stories for each image to familiarize themselves with what to expect. Thus, the creativity ratings of the stories were relative to the other stories written in the same situation.

Measures of effort. The study also included two measures designed to ascertain how much effort *P*s put into writing each story. First, the amount of time *P*s took to work on each story (maximum 5 min) was recorded. Second, the number of words *P*s used to compose each story was also counted.

Results

Overview of Stories

The stories written by participants showed quite a bit of variability in creativity. Because *P*s were not specifically instructed to be creative, a sizable portion of the stories were somewhat bland. For instance, when writing about the cartoons, some *P*s merely wrote a sentence or two describing the situation with little additional insight (e.g., for the prison cartoon: "These are two men in prison. They are there because they were suspected of terrorism." For the café cartoon: "These two people work together and are on a break from work at a coffee shop."). However, many *P*s were also inspired to spontaneously include more information, which usually resulted in more creative answers, as in the following description of what could be going on in the café:

> Nigel is trying to decide whether or not to a get a nose job. He just can't decide. However, his friend Reginald had one and his nose was simply stunning. Reginald is a very particular sort of fellow you know. That latte he's drinking had to be just so. Soy milk with a dollop of foam and merely a whisper of cinnamon. Too much of one ingredient might completely throw off the balance of his day. When

> one is so particular about cinnamon, you could only imagine how he'd prefer his nose. All of these things Nigel noted to himself as Reginald went on and on.

Despite the fact that *P*s wrote about what could be interpreted as a comedic cartoon, the majority of the answers lacked any element of humor. Only a few participants responded to the cartoon question by writing a witty one-sentence tagline common in comic strips (e.g., for the two imprisoned men in shackles: "I am badly in need of a pedicure.").

The two abstract images had fewer standard responses. Although something about a psychedelic experience was periodically mentioned, a good portion of *P*s made up a more interesting short description (e.g., "I think in this painting there's a butterfly breaking out of its cocoon. However, I think this is a metaphor for someone breaking free of their past" or "I see a basketball game in a poor neighborhood with a lot of graffiti. The people are playing because they hope that basketball will help them get out of this neighborhood."). Multiple *P*s wrote responses that were more interesting, such as the following:

> The setting is a seedy, underground jazz club, where bands have to compete with drug dealers for the patrons' attention. A good quintet is performing, with a tenor saxophone, two trumpets, a trombone and a drummer. The instruments are old and worn, but the music that they make is enough to turn the attention of the crack dealers and the junkies. The music is haphazard and at times seems arrhythmic and amelodic, but it fits the scene like a velvet glove.

Story Creativity

The eight measures of creativity showed high cohesiveness for each of the four judges (alphas for the eight ratings for each judge ranged from .88–.94).[2] Thus, the eight ratings were combined into a creativity index for each of the four coders. The ratings of all four coders also showed high interrater reliability ($\alpha = .86$ for the cartoon; $\alpha = .88$ for the painting), and the ratings for the four judges were combined into a creativity index for the cartoon and a creativity index for the painting.

We next tested whether the postmanipulation creativity ratings of the stories about the cartoon and the painting were differentially influenced by *P* sex and the prime manipulation. This was done via a repeated-measures mixed-model 3-factor analysis of covariance (ANCOVA) with the premanipulation creativity ratings as a covariate; *P* sex and prime were entered as between-participants factors and type of image was entered as a within-participants factor. As expected, type of image did not interact with *P* sex or prime (all ps $> .35$), meaning that creativity for both types of images was similarly affected by the prime and by *P* sex. Thus, the creativity indices for the two types of stories were combined in the remainder of the analysis.

The mean rating of creativity for the premanipulation (covariate) stories was 3.83 ($SD = 1.41$). Men tended to be more creative than women ($M = 4.30$, $SD = 1.65$ for men vs. $M = 3.54$, $SD = 1.15$ for women; $p = .011$). To test the specific hypotheses of the study, we performed two planned comparisons—one for men and one for women—using the premanipulation creativity scores as a covariate, which took into account the differences at baseline. For men, the mating prime significantly elevated creativity compared with men in the control, $t(86) = 2.81$, $p = .006$, $\eta^2 = .088$ (see Figure 1). However, for women the same romantic prime had no effect on their creativity compared with the women in the control, $t(86) = .17$, $p = .88$. Thus, results supported the male-only creative display hypothesis, indicating that mating cues increased creativity for men but not for women.

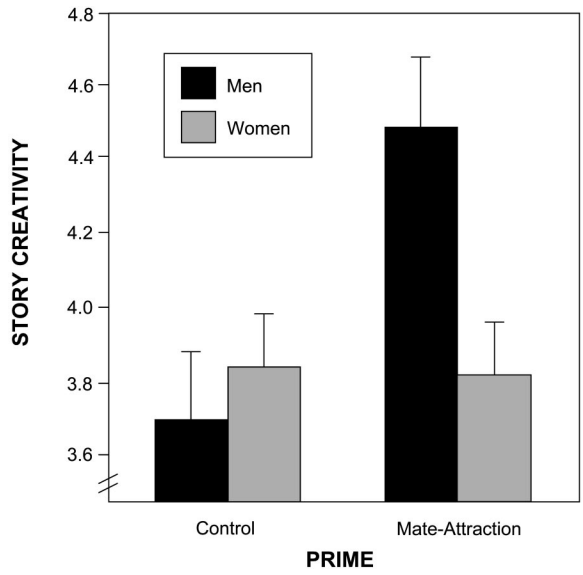

Figure 1. Men's and women's story creativity depending on type of prime in Study 1 with standard error bars (adjusted means).

Expended Effort

The amount of effort *P*s expended on each story was assessed by the amount of time they took to write the stories and the number of words used. We first assessed whether the prime manipulation had a similar impact on the expended effort measures for the two types of postmanipulation images. One ANCOVA was performed on time taken to write the story using the premanipulation time as a covariate, and another ANCOVA was performed on number of words in a story using the premanipulation number of words as a covariate. Both analyses indicated that type of image did not interact with *P* sex or with prime (all ps $> .3$), meaning that the primes had a similar effect on both men's and women's effort on stories about the cartoon and the painting. Thus, the effort measures for the two types of stories were collapsed.

A two-factor ANCOVA on time spent writing the stories with the premanipulation time as a covariate revealed no significant interaction or main effects of *P* sex and prime (all ps $> .35$). A two-factor ANCOVA for the number of words used in the stories with the premanipulation words as a covariate also showed no significant main effects of *P* sex and prime (all ps $> .13$) or interaction ($p > .70$). Overall, despite a difference for men in the creative quality of the stories in the mating prime condition, there was no indication that this creative jump was related to exerting more effort—spending more time or words—on the stories.

[2] Of the eight measures, humor had the lowest correlation with the other seven measures. This was primarily because very few *P*s (less than 20%) received a rating above 1 on humor. However, when *P*s did display humor it was generally considered very creative, and humor still had a correlation above .50 with each of the other seven measures.

Discussion

The results of Study 1 supported the male-only creative display hypothesis, whereby a mating prime stimulated only men to write stories that were judged as more creative. Notably, this creative boost occurred despite there being no actual incentive for men to be more creative; that is, the stimuli were photographs and the romantic situations were imaginary. This creative increase was also not accompanied by a parallel increase in either the time spent or the number of words used to write the stories. Thus, it does not seem that a mating prime generated greater creativity because it induced participants to exert more effort into writing the story. Instead, mating cues appear to inspire an increase in the quality of men's displays.

Study 2

Although the results of Study 1 were supportive of the male-only creative display hypothesis, the findings were limited. For instance, research indicates that men are more sexually aroused by visual images than women (Hamann, Herman, Nolan, & Wallen, 2004). Because the key part of the mating prime procedure consisted of viewing photographs of attractive individuals, it is possible that this procedure may have been stronger at inducing a romantic mindset for males than for females.

However, if the priming procedure was successful for both men and women, the lack of a creative spike for females is both slightly puzzling and highly instructive. It is puzzling because prior research indicates that both men and women indicate a relatively equal preference for creativity in a mate (Li et al., 2002). Moreover, because women's creative displays are likely to be attractive to potential mates, it seems odd that courtship would not spur creativity. However, the lack of a creative increase for women in Study 1 is also instructive: Perhaps it reflects a tendency for women to not display their creativity when encountering a particular type of potential mate but not when encountering other types of potential mates.

Short-Term and Long-Term Mating Strategies

A closer inspection of the research on human mating indicates abundant evidence that women and men behave differently in their pursuit of long-term and short-term mates (Buss & Schmitt, 1993; Gangestad & Simpson, 2000; Kenrick, Sadalla, Groth, & Trost, 1990). Whether a relationship is likely to be short-term (e.g., a one-night stand) or long-term (e.g., a marriage) has vastly different implications for the expected parental investment of men and women. If offspring result from a short-term mateship, the female is likely to contribute the majority of parental investment, whereas the male contributes practically nothing. Within a long-term relationship, however, both parents expect to contribute significantly to offspring.

A short-term relationship is more akin to courtship in the vast majority of other mammalian species, in which fathers contribute little or nothing to the offspring. Under such circumstances, females tend to be highly selective about their mating partners, choosing only those mates who manifest characteristics associated with good genes (Gangestad & Simpson, 2000). Consequently, in most mammalian species and in many other vertebrate species such as the peacock, it is the male who does the displaying, and the female who does the evaluating. When people are pursuing a short-term strategy, therefore, it would be expected that only the males would increase their displays of creativity. It seems likely that just this kind of a romantic relationship was made salient in Study 1, in which participants saw photos of multiple attractive opposite sex strangers and had no information indicating whether these strangers were potential long-term mates. Moreover, attractive males may be more likely to be perceived to be inclined toward unrestricted mating strategies (Gangestad, Haselton, & Buss, in press).

Unlike most other mammals, however, human mating often involves substantial investment by fathers—up to and including a lifetime monogamous commitment of the male's effort and resources. High male parental investment, though rare in mammals, tends to coevolve with slow-developing high-cost offspring that are helpless at birth (Geary, 2000). In species with high male parental investment, fathers and mothers invest a great deal in a long-term mate, and both sexes tend to be choosy about the characteristics of a long-term partner. It would follow that when people are pursuing a long-term mate, both men and women would be under selective pressure to display desirable sexually selected characteristics, including the ability to be creative.

Study 2 tested whether priming participants with cues for an explicitly short-term versus a long-term mating situation would produce a different pattern in creative displays for males versus females. Given cross-species findings and differences in expected parental investment for the two types of mating strategies, two predictions were generated. For men, it was predicted that both short-term and long-term mating primes would elicit creativity. However, for women it was predicted that only the long-term prime would produce a creative boost. To prime the two different mating situations, all participants read a short scenario in which they imagined themselves desiring a short-term or a long-term mate. To avoid the potentially problematic sex difference in arousal to visual cues, we did not use photographs.

Method

Participants

Two hundred participants (64 men and 136 women) were recruited from introductory psychology classes as partial fulfillment of their class requirement.

Design and Procedure

The study design was a between-participants 2 (*P* sex) × 3 (Prime: short-term mating vs. long-term mating vs. control) design. The general procedure of the study was very similar to that of Study 1, including using the identical method to measure creativity. However, the method used to prime mating was different.

Mating primes. All *P*s read and imagined themselves in one of three scenarios (short-term mating, long-term mating, and control) that were of similar length (about 850 words). In the short-term scenario, *P*s imagined themselves during the last day of their vacation on an exotic island. On this last day they met a desirable person and spent a romantic afternoon and had dinner with the new romantic interest. The scenario ends as the two lovers are passionately kissing on a moonlit beach. The short-term scenario repeatedly emphasized that the two people would likely never see each other again.

In the long-term scenario, *P*s imagined meeting someone desirable on the university campus. *P*s imagined spending a wonderful afternoon and a

romantic evening with this person, including a candlelight dinner and a sweet kiss goodnight. Throughout the scenario, the reader ponders that this person may be a good long-term partner, and the scenario ends as the reader is anticipating going out on an "official" first date with this person.

In the control scenario, *P*s imagined getting ready to go to a much-anticipated concert with a same-sex friend. During the night of the show, *P*s imagined that they could not find the tickets. However, the scenario has a happy ending as the friend shows up with the tickets, and they both head off in a great mood anticipating a delightful musical experience.

To test whether the scenarios were successful at eliciting romantic feelings, self-report measures of romantic and sexual affect were collected from a total of 58 male and female *P*s. After reading one of the three scenarios, *P*s indicated to what extent they were experiencing sexual and romantic arousal on a 7-point scale with the endpoints at 1 (*not at all*) and 7 (*very much*). Results indicated that there were no differences in the measures across the two romantic scenarios for men or women (all *p*s $>$ .35). However, compared with *P*s in the control scenario, *P*s who read the mating scenarios reported significantly more romantic arousal (mating $M = 5.88$, $SD = .61$; control $M = 1.85$, $SD = .48$; $p < .01$) and significantly more sexual arousal (mating $M = 4.93$, $SD = .78$; control $M = 1.18$, $SD = .29$; $p < .01$).

Priming booster shots. As in Study 1, the current experiment had a booster of the prime manipulation after *P*s wrote the first postprime creative story. In the booster for both romantic prime conditions, *P*s were asked to imagine themselves back in the scenario that they read earlier. Then, *P*s were given up to 3 min to write in detail about what physical characteristics they would desire in this person. In the control condition, *P*s were also asked to go back to the scenario they read earlier. However, they wrote about the physical characteristics of the anticipated concert venue.

Dependent measures. As in Study 1, four student judges (two men and two women) who were blind to experimental condition rated the stories on the same creativity dimensions. The amount of time *P*s spent writing each story and the number of words used were also recorded.

Results

Creativity

The eight creativity measures again showed high cohesiveness for each of the four judges (alphas for the eight ratings for each judge ranged from .90–.94), so the eight measures were combined into a creativity index for each judge. The ratings of all four judges also showed high interrater reliability ($\alpha = .87$ for the cartoon; $\alpha = .88$ for the painting). Thus, the ratings for the four judges were combined into a cartoon creativity index and a painting creativity index.

To test whether the prime had a similar effect on men's and women's creativity on each type of postmanipulation image, we used the same analysis strategy from Study 1. A repeated-measures mixed-model 3-factor ANCOVA with type of image as a within-participants factor and the premanipulation ratings of creativity as a covariate again indicated that type of image did not interact with the other two factors (all *p*s $>$ .60). Thus, the creativity indices for the two types of stories were combined into one measure.[3]

The mean rating of creativity for the premanipulation (covariate) stories was 4.18 ($SD = 1.44$), and males again tended to be more creative than females at baseline ($M = 4.52$, $SD = 1.48$ for males vs. $M = 4.02$, $SD = 1.40$ for females; $p = .021$). To test the specific hypotheses of the study, we performed a series of planned contrasts using the premanipulation stories as covariate, which took into account the differences at baseline.

It was predicted that both of the romantic scenarios would increase men's creativity. As seen in Figure 2, men in the long-term condition did indeed write significantly more creative stories than men in the control condition, $t(193) = 3.77$, $p = .003$, $\eta^2 = .047$. Although men in the short-term mating condition also displayed more creativity than men in the control condition, this difference was only marginally significant, $t(193) = 1.69$, $p = .096$, $\eta^2 = .016$.[4] Nevertheless, men in the long-term and the short-term conditions did not differ from one another, $t(193) = 1.41$, $p = .16$, and the combination of the two mating conditions was significantly different from the male control condition, $t(193) = 2.71$, $p = .009$, $\eta^2 = .037$. Thus, both a short-term and a long-term mating prime boosted men's creative displays to some extent.

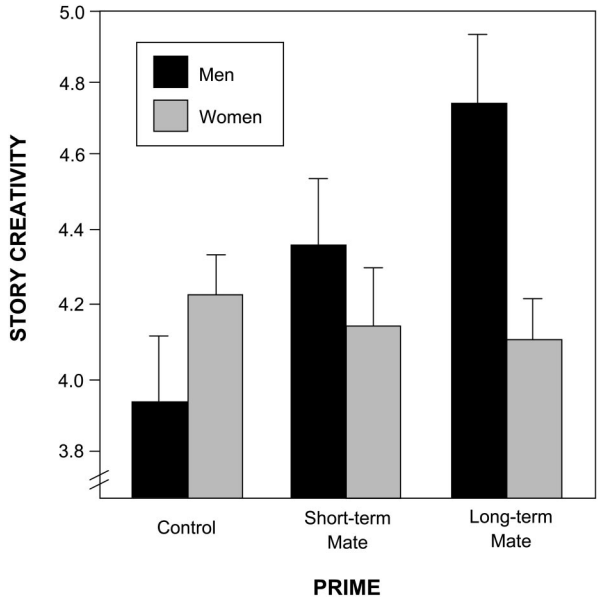

Figure 2. Men's and women's story creativity depending on type of prime in Study 2 with standard error bars (adjusted means).

As expected, women in the short-term mating condition showed no significant difference in creativity from women in the control, $t(193) = .34$, $p = .73$. This predicted lack of difference conceptually replicated the findings for women from Study 1. However, a planned comparison of the long-term mating prime and the control conditions did not indicate the predicted increase in creativity for women, $t(193) = .98$, $p = .32$. Thus, neither the

[3] The lack of interactions also indicates that imagining the physical characteristics of the potential mate in the booster shot did not have a different impact on creativity than just reading the original scenario.

[4] The slightly lower creativity for men in the short-term versus the long-term condition can be primarily attributed to 2 *P*s, who reported currently being in a committed romantic relationship and showed a sizable creative drop after imagining pursuing a short-term fling. However, the identical short-term scenario did produce significant increases in male creativity in Studies 3 and 4, and *P*s' current relationship status did not significantly affect the results in any of the studies. In addition, analyses of *P*s' sociosexual orientation (Simpson & Gangestad, 1991, 1992) and creativity in the different conditions also did not indicate any significant effects, perhaps because the scenarios primed specific mating strategies irrespective of a person's sociosexual inclination.

short-term nor the long-term mating primes boosted women's creativity.[5]

Expended Effort

Two three-factor ANCOVAs (one for time and one for number of words) again indicated that type of image (cartoon or painting) did not interact with either *P* sex or prime (all *p*s > .60). Thus, the effort measures for the two types of stories were collapsed. An ANCOVA for time spent writing the stories again indicated no significant interaction or main effects of *P* sex or prime (all *p*s > .40). An ANCOVA for the number of words used in the stories also indicated no significant interaction or main effects (all *p*s > .30).

Discussion

The results of Study 2 provided further qualified evidence that cues related to mating can lead to an increase in displayed creativity, at least in males. As predicted, men showed an increase in creativity when primed with thoughts of pursuing either a short-term or a long-term mate. Also as predicted, women did not show an increase in creativity in the short-term prime condition. However, contrary to prediction, women failed to show an increase in creativity in the long-term condition. The overall pattern for men and women was consistent with the results of Study 1. Also following the results of Study 1, none of the increases in creativity produced by the mating primes was accompanied by any indication of increased effort to produce the display.

Study 3

Although the results of Study 2 supported a mating-inspired increase in creativity for men, the supposed long-term mating prime did not lead to the predicted increase in women's creative displays. Why not? First, it is possible that as in many species, women may simply not display this sexually selected characteristic in courtship. Instead, women may have evolved creative abilities primarily to judge the quality of men's creative displays (Miller, 2000). However, it is possible that our long-term mating prime manipulation, which involved preparing for a first date with a man who had long-term potential, may have been insufficient to reach the threshold for women's mating-linked displays of creativity.

Because women incur significantly higher reproductive costs if they are abandoned by their mates, women selecting a long-term mate should be especially focused on and sensitive to the trustworthiness and commitment levels of the man (Haselton & Buss, 2000; Hrdy, 1999; Hurtado, Hill, Kaplan, & Hurtado, 1992). Following this logic, women would need to be assured of the trustworthiness and the commitment level of a potential mate before committing themselves strongly. This reasoning is consistent with findings that women are, compared with men, slower to report feelings of love during courtship and have a higher desire for commitment from their romantic partner before consenting to sex (Peplau, 2003). Women are also, compared with men, relatively more conservative about believing professions of love by members of the opposite sex (Haselton & Buss, 2000). Although the long-term scenario used in Study 2 specified that the imagined mate was a potential long-term partner, the overall perceived mate quality of the person—especially as it relates to trustworthiness and commitment—may have been too ambiguous to ensure that women would perceive this person to be a truly high-quality mating prospect. Study 3 was undertaken to examine this possibility.

Study 3 was conceptually similar to Study 2, except that a new key condition was added in which men and women read about a long-term mate who was a clearly committed long-term partner. The results of Study 2, along with male and female differences in parental investment, led to two separate predictions—one for men and one for women. For men, it was predicted that creativity would increase after all of the three mating primes. However, the pattern for women was predicted to be distinctly different: The committed long-term mating prime should be the only one to produce a higher level of creativity when compared with the other conditions, which should again not differ from one another.

In an attempt to explore whether specific mating cues can produce creative boosts in other domains of creativity besides story-writing, Study 3 also used a different measure of creativity—the Remote Associates Test (RAT; Mednick, 1962). The RAT was originally developed as an objective test of creativity, whereby creativity is defined in a much narrower scope: Creativity is the ability to make rapid appropriate associations between various concepts. Each RAT question consists of providing people three words (e.g., "dress, dial, flower") and giving them a limited amount of time (15 seconds in the current study) to come up with the one correct word linked to all three of the original words ("sun"). Success on the RAT has been shown to correlate reliably with success on classic insight problems, and the RAT is often used in the study of creative problem solving (Bowden & Beeman, 1998; Schooler & Melcher, 1995).

Finally, to assure that the results of Studies 1 and 2 were not caused by some peculiar effect produced by the content of the control conditions, Study 3 used a no-prime control condition. That is, participants in the control did not read a scenario.

Method

Participants

One hundred and fifty-seven participants (85 men and 72 women) were recruited from introductory psychology classes to participate as partial fulfillment of their class requirement.

Design and Procedure

The design of the study was a between-participants 2 (*P* sex) × 4 (Prime: short-term vs. potential long-term vs. committed long-term vs. control) design. The conceptual procedure was similar to that of Study 2, except for the addition of a new romantic scenario for the committed long-term condition and the use of the RAT to assess creativity.

RAT. The RAT can be administered using any number of questions while giving *P*s any amount of time to answer them. In the current study, *P*s saw 40 RAT-like questions and had 15 s to answer each question. The

[5] In addition to judging creativity, the stories were also judged on the perceived intelligence of the participant. The measures of intelligence showed high concordance with the measures of creativity, whereby the mating primes led males to be perceived as more intelligent. However, it may have been difficult to meaningfully separate creativity and intelligence within the judging context, making it uncertain whether mating primes indeed boosted a purer form of intelligence display.

first 20 questions were used to establish a baseline score for each *P* regarding their general RAT performance. Then, after the priming manipulation, *P*s worked on a different set of 20 RAT questions; performance on this last set of 20 constituted the dependent measure in the study. All of the specific RAT questions were adapted from Bowden and Beeman (2003), who provide normative statistics regarding the percentage of people who tend to solve specific RAT questions within various time limits. The 40 questions used in the current study were shown to have been solved 40%–60% of the time within a 15-s time limit by university students. *P*s in all conditions responded to the same first set of 20 questions (baseline) and to a different set of 20 subsequent questions (dependent measure). The two sets were matched to be of equal difficulty, and the order of the questions within each set of 20 was randomized.

Mating primes. The same procedure from Study 2 was used to prime mating. Two of the romantic scenarios (short-term and potential long-term) were identical to those used in Study 2, except that the original long-term scenario has now been labeled potential long-term. To prime cues of a committed high-quality long-term mate, a brief paragraph was added to the original long-term scenario. The paragraph contained three new pieces of information: (a) the couple had already been dating for a while, which was intended to signify commitment; (b) the *P* had met and approved of the target's friends, which was intended to signify trustworthiness; and (c) the target had met the *P*'s friends who had given their approval, which was intended to signify that the target was good relationship material. Unlike in Studies 1 or 2, *P*s in the control condition did not read a story or see any photos. Instead, they were given a short break and saw a blank screen before continuing to the next set of RAT questions.

Priming booster shot. As in Studies 1 and 2, all *P*s received a booster shot to refresh the mating prime after completing the first 10 of the second set of the dependent-measure RAT questions. The specific nature of the booster shot was identical to that in Study 2, in which people were asked to write about the physical characteristics of the imagined person from the romantic scenario. In the control condition, participants were merely given another short break and saw a blank screen before continuing with the remaining 10 RAT questions.

Results

Creativity

For the 20 baseline RAT questions, participants solved 8.72 (SD = 3.44) questions, and there were no sex differences in performance. In addition to testing the predictions of the study via planned contrasts, we also tested whether the predicted contrasts explained most of the between-cell variance by testing the residual contrast, which was predicted to be nonsignificant (see Levin & Neumann, 1999).

Male creativity. For men, it was predicted that the three mating primes would produce a higher level of creativity than in the control condition. As seen in Figure 3, a planned contrast using the baseline RAT measures as covariates indicated that this was indeed the case, $F(1, 80) = 2.58$, $p = .012$, $\eta^2 = .077$. Creativity in the three mating conditions did not differ from one another ($p = .99$). The test of the residual contrast was also not significant, F_{residual} (2, 80) = 0.55, *ns*, meaning that the predicted contrast accounted for most of the between-cell variance.

Female creativity. For women, it was predicted that only the prime for the committed long-term mate would produce a creative boost above that of the other three conditions. As seen in Figure 3, a planned contrast with baseline RAT scores as the covariate indicated that this was indeed the case, $F(1, 72) = 2.03$, $p = .048$, $\eta^2 = .056$. As would be predicted from Studies 1 and 2, the remaining three conditions—short-term, potential long-term, and control—did not differ from one another ($p = .70$). The test of the residual contrast was also not significant, F_{residual} (2, 72) = 2.96, *ns*, meaning that the predicted contrast explained most of the between-cell variance in creativity. Thus, women showed a creative increase only when they were primed with thoughts of a committed long-term mate who was clearly high-quality relationship material.

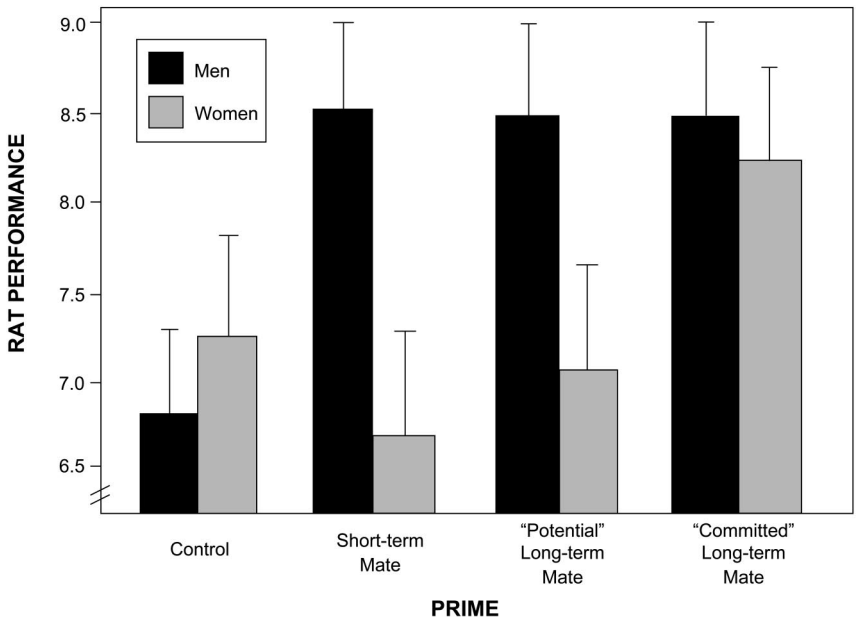

Figure 3. Men's and women's performance on the Remote Associates Test (RAT) depending on type of prime in Study 3 with standard error bars (adjusted means).

Differences in Imagined Mate Across Scenarios

To examine whether participants indeed perceived the key differences across the romantic scenarios, we collected additional data to ascertain what *P*s actually perceived to be the differences and similarities of the imagined mate in each of the three scenarios. A total of 92 separate male and female *P*s underwent the same priming procedure used in the current study, whereby each person only read one of the three scenarios. Afterward, *P*s indicated the quality of various characteristics regarding the person whom they imagined desiring in the scenario. More specifically, *P*s were asked 13 questions in random order that were generally phrased in the following way: "To what extent is this person _____ ," and *P*s provided their responses on a scale of 1 (*not at all*) to 9 (*very*).

The questions asked about the imagined mate's perceived trustworthiness (trustworthy, truthful, honest; $\alpha = .93$), level of commitment (committed, faithful, likely to cheat [reverse scored]; $\alpha = .80$), and desirability as a long-term partner (good relationship material, the right person for me, confidence that they're a good boyfriend or girlfriend; $\alpha = .91$). In addition, *P*s were also asked to report the extent to which the potential mate was seen as being creative, intelligent, funny, and physically attractive. To test whether men and women differed in their perceptions of the mate on the characteristics across the scenarios, 13 two-factor analyses of variance (*P* sex × Prime) were performed. Results indicated no significant interactions (all *p*s $> .30$). Thus, male and female ratings were combined for the remainder of the analysis.

As seen in Table 1, *P*s did indeed perceive different levels of trustworthiness, commitment, and long-term mate value across the three conditions: The short-term mate was always perceived as having the least of the three qualities, and the committed long-term mate was always perceived as having the most of the three qualities. When compared with the potential long-term scenario, the person imagined in the committed long-term scenario was perceived as significantly more trustworthy, $t(89) = 2.48$, $p = .015$, $\eta^2 = .064$, more committed, $t(89) = 2.10$, $p = .038$, $\eta^2 = .047$, and of higher long-term mate quality, $t(89) = 2.08$, $p = .040$, $\eta^2 = .047$. Thus, men and women did perceive the key differences between the two long-term primes. Analyses of *P*s' perceptions of physical attractiveness, creativity, intelligence, and humor indicated no significant differences among the three conditions (all *p*s $> .30$), with all of the ratings being relatively high (see Table 1 for ratings of attractiveness and creativity as an example).

Table 1
Perceived Attributes in Imagined Mate Depending on Scenario

	Type of romantic scenario		
Perceived attribute	Short term	Potential long term	Committed long term
Trustworthy	6.00 (1.58)	6.69 (1.18)	7.53 (1.25)
Committed	5.32 (1.48)	6.43 (1.16)	7.15 (1.55)
Relationship material	5.83 (1.82)	7.01 (1.46)	7.77 (1.14)
Intelligent	8.84 (0.76)	8.00 (1.02)	8.16 (1.32)
Creative	6.85 (1.46)	6.75 (1.27)	6.97 (1.14)

Note. Means are on a 1–9 scale in which higher numbers indicate more of the perceived characteristic. Numbers in parentheses denote standard deviations.

Mood and Arousal

One possible mechanism for how the romantic primes may have produced the specific patterns of creativity was by influencing men's and women's mood or arousal. To investigate this possibility, a separate group of a total of 63 male and female *P*s underwent the priming procedure from Study 3. Afterward, *P*s rated to what extent they felt positive arousal (energetic, excited, passionate; $\alpha = .75$), negative arousal (upset, tense, nervous; $\alpha = .83$), and positive mood (happy, upbeat, joyful; $\alpha = .83$). Ratings were provided on a 1 (*not at all*) to 7 (*very much*) scale.

Results indicated that none of the romantic primes produced much negative arousal for men or women (*M*s between 1.98 and 2.40). However, the patterns for positive mood and positive arousal were instructively different across the different conditions (see Table 2). For men, the two long-term primes produced similar levels of mood and arousal, and ratings for both primes were slightly (nonsignificantly) higher than those for the short-term prime. For women, mood and arousal for the two long-term mating primes also did not differ from each other, and both were significantly higher than the mood and arousal produced by the short-term prime ($p < .05$). This overall pattern for women is quite different from the pattern of women's performance on the RAT. Specifically, although the two long-term conditions produced highly similar patterns of positive mood and positive arousal, women's RAT performance in these two conditions differed. Moreover, despite men's and women's different performance on the RAT in the short-term mating condition, the short-term scenario produced no sex differences in positive arousal or mood (all *p*s $> .60$). Taken as a whole, the RAT performance patterns produced by the romantic scenarios appear to be different from the mood and arousal patterns produced by these primes.

Discussion

Results from Study 3 provided a clearer picture of how mating cues influence creativity. Study 3 replicated both the short-term and the (potential) long-term findings from Study 2. It is important to note that these results were replicated with a different measure of creativity—the RAT—and a no-prime control condition. As predicted, Study 3 also showed that when participants were primed with the desire for a committed long-term mate—a mate who was perceived to be more trustworthy, committed, and generally better relationship material—both men and women showed higher levels of creativity. This finding supports the notion that when males or females are pursuing a mating strategy in which they each expect to contribute significant parental investment, both sexes are likely to display a sexually selected trait such as creativity. However, men and women appear to have different mate-quality thresholds for displaying creativity: For men, the requirements are relatively low—the desire to attract any desirable woman will do; for women, the requirements are high—only a desire for a long-term mate who is clearly a high-quality mate produces the display. Additional data also indicated that the precise pattern of creative boosts for men and women could not be explained solely by the arousal or positive mood that were produced by each of the romantic scenarios.

Study 4

Thus far, findings from all three studies show that specific cues related to mating can produce an increase in creativity for men and

Table 2
Men's and Women's Mood and Arousal Depending on Scenario

	Type of romantic scenario		
	Short term	Potential long term	Committed long term
Positive mood			
Males	4.42 (1.65)	5.00 (1.27)	5.07 (1.16)
Females	4.27 (1.65)	5.70 (0.85)	5.73 (0.77)
Positive arousal			
Males	4.18 (1.94)	4.54 (1.61)	4.57 (1.41)
Females	3.67 (1.90)	5.03 (0.96)	5.20 (0.92)

Note. Means are on a 1–7 scale in which higher numbers indicate a more intense state. Numbers in parentheses denote standard deviations.

women. However, would mating cues continue to produce a creative boost when compared with people who are motivated to do well on the creative task? To test this question, the current study used a methodology almost identical to that of some conditions of Study 3, except that it added a key new condition in which participants were provided with a monetary incentive to do well on the RAT but in which no romantic prime was used—the monetary incentive condition. The study had two competing hypotheses with different implications for the process by which mating cues may stimulate creativity. First, it was plausible that *P*s in the monetary incentive and the men in the (short-term) mating condition would perform significantly better on the RAT than the *P*s in the control condition. Such a result would indicate that mating cues might facilitate creativity by motivating people to somehow work harder at the task. However, a different outcome was also deemed plausible. The second possibility was that men in the mating condition would perform significantly better than men in any of the other conditions. Such a result would indicate that mating cues do not increase creativity simply by leading people to try harder at the task.

Method

Participants

One hundred and sixty-seven participants (78 men and 89 women) were recruited from introductory psychology classes to participate as partial fulfillment of their class requirement.

Design and Procedure

The design of the study was a between-participants 2 (*P* sex) × 3 (Condition: mating vs. control vs. monetary incentive) design. The procedures in the (short-term) mating and the control prime conditions were identical to those of Study 3. In the monetary incentive condition, the procedure was similar to that of the control, except that before *P*s started the last 20 RAT problems, they received the following instructions: "On the remaining problems, we would like you to try your hardest to do the best you can. If you are in the top 30% of everyone's scores, you will be entered in a raffle to win $60!"

Results

Motivation Check

After *P*s finished the RAT questions, they were asked to what extent they were motivated to do well on the 20 postmanipulation RAT problems. This question served as a manipulation check of the incentive instructions. Analyses indicated that motivation for men and women did not interact with condition ($p > .70$), and that men's and women's motivation did not differ from each other across the three conditions (for men, $M = 4.79$, $SE = .16$; for women, $M = 4.80$, $SE = .15$), $F(2, 161) = .085$, $p = .92$. Thus, the motivation scores for men and women were combined. Results also indicated that *P*s in the mating and control conditions also did not differ from each other in motivation (for mating, $M = 4.59$, $SE = .18$; for control, $M = 4.71$, $SE = .19$; $p = .63$). Thus, these two groups were combined into a no-incentive condition.

A comparison of the monetary incentive condition and the combined no-incentive group revealed that participants in the monetary incentive condition reported being significantly more motivated to do well on the RAT items (for monetary incentive, $M = 5.09$, $SE = .19$; for no incentive, $M = 4.65$, $SE = .13$), $F(1, 165) = 3.90$, $p = .051$, $\eta^2 = .023$. Thus, the manipulation to induce motivation to do well on the task had the desired effect.

Creativity

For the 20 baseline RAT questions, participants solved 8.01 ($SD = 3.12$) questions and there were no sex differences in performance. To test the specific hypotheses of the study, we performed a series of planned comparisons using the baseline RAT scores as a covariate. First, examining the men, a planned contrast revealed the predicted increase in RAT performance in the mating condition when compared with the control condition, $t(160) = 2.83$, $p = .005$, $\eta^2 = .048$. However, as seen in Figure 4, men in the mating condition also performed significantly better than men in the monetary incentive condition, $t(160) = 2.21$, $p = .029$, $\eta^2 = .030$. Although men in the monetary incentive condition performed slightly better than men in the control condition, this difference

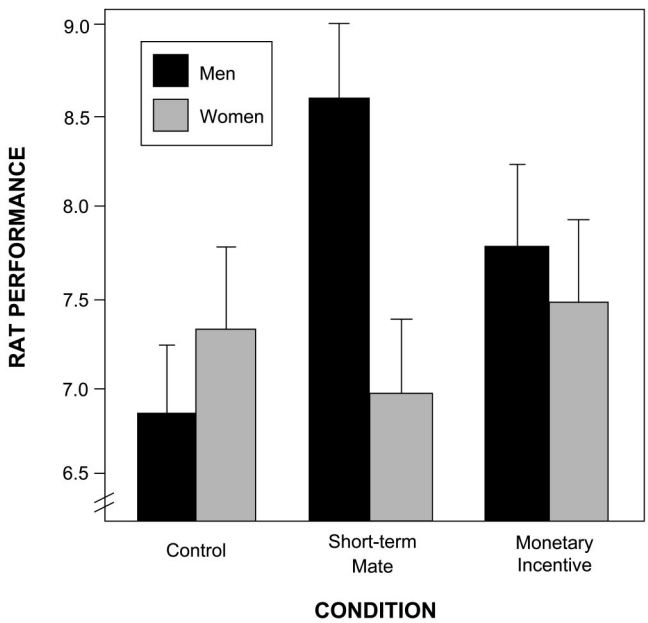

Figure 4. Men's and women's performance on the Remote Associates Test (RAT) depending on condition in Study 4 with standard error bars (adjusted means).

was not significant ($p = .31$). For women, there were no significant differences across conditions, $F(2, 85) = 2.24$, $p = .44$.

Discussion

The results of Study 4 indicated that men primed with mating cues performed better on the creativity task even when compared with people who were trying harder at the task. Previous research (Amabile, 1996) has indicated that extrinsic motivation, such as a monetary incentive, does not always result in higher creative quality, so perhaps the finding that an incentive to do well on the RAT did not significantly improve performance is not surprising. However, the fact that a mating prime led to a creative boost above that produced by merely trying hard at the task suggests that the process by which mating cues stimulate creativity is not related to external motivation. Consistent with the findings from Studies 1 and 2, the mating-inspired creative boost appears to be unrelated to expending more effort on the creative task.

General Discussion

The current research set out to explore whether priming men and women with a variety of theoretically relevant mating cues would lead to an increase in creativity. This question was tested in four studies, in which men and women first either looked at photographs of attractive opposite sex individuals (Study 1) or imagined being in a particular romantic scenario (Studies 2–4), and then performed tasks assessing creativity on subjective (Studies 1 & 2) or objective (Studies 3 & 4) measures. For men, cues designed to stimulate a motive to attract either a desirable short-term or a long-term mate produced an increase in creativity. That is, after just thinking of attracting a desirable woman as any kind of a romantic partner, men showed an increase in creativity—even if they themselves could not actually benefit romantically from this creative burst in the current setting. In contrast, women only increased their creative output after imagining wanting to attract a clearly high-quality (i.e., trustworthy and committed) long-term mate. Women did not show a creative increase when primed to think about attracting a short-term mate or a potential long-term mate who had yet to prove his worth as good relationship material.

These findings are consistent with the theories of sexual selection and differential parental investment. When pursuing a short-term mating strategy, women are expected to provide the vast majority of parental investment. In other species, selectively high female investment is also associated with courtship displays primarily by males. For example, male bowerbirds, who do not contribute direct resources to offspring, have evolved to construct elaborate bowers during courtship; they then artfully decorate the bowers with a colorful assortment of flower petals, berries, and snail shells, or even "paint" it with regurgitated bluish residue (Borgia, 1986). Females inspect the bowers and preferentially mate with males who have the largest, most symmetric, and best decorated displays because, like the peacock's tail, the creative bower displays seem to serve as a reliable indicator of fitness (Borgia, 1995).

When pursuing a long-term mate, however, both men and women expect to invest significantly in offspring. In other species, high male parental investment is associated with both sexes being choosier when selecting a mate and with both sexes tending to display desirable qualities in courtship. Such a pattern can be seen in gibbons, in which each sex invests substantially in offspring. During courtship, both male and female gibbons have evolved to sing complex and elaborate musical patterns to each other—a behavior called *dueting* (Geissmann, 2000; Raemaekers & Raemaekers, 1984). Despite the fact that human males often invest substantially in shared offspring, women always stand a reasonable danger of substantially higher costs if they choose a long-term mate who does not intend to commit (Kenrick et al., 1990). In this light, it makes some sense that women require assurance that a prospective mate is really going to invest in offspring before investing the energy in creative displays.

The Psychological Mechanism

The current research examined several plausible psychological processes by which mating cues could stimulate creativity. Results from three of the studies indicated that mating cues are unlikely to elicit creativity by stimulating one to try harder to be creative. In Studies 1 and 2, participants neither spent more time nor used more words to write creative stories. In addition, participants given a monetary incentive in Study 4 still performed worse than people primed with mating cues. Although it is possible that a chance to win $60 may not have been a strong incentive, participants in this condition nevertheless reported being more motivated to try harder.

Study 3 indicated that the mood and arousal states produced by each of the specific romantic scenarios showed a distinctly different pattern from that of creativity. For instance, although women were equally positively aroused by the potential and the committed long-term mate scenarios, only the committed scenario produced a creative boost for women. Moreover, men and women reported relatively equal mood and arousal after reading the short-term scenario, although only men showed a creative increase in that situation. Although the mood and arousal ratings were self-reported, these findings suggest that the particular pattern of increases in creativity cannot be explained solely by changes in mood and arousal—or at least the kind of general arousal typically measured in psychological research.

A third process, which we believe is most likely to underlie these effects, can be inferred from Studies 3 and 4, in which the RAT was used to assess creativity. Because the purpose of each RAT question is to ascertain whether a person can rapidly locate a particular concept in their mind, the RAT is an appropriate and rather specific test of the accessibility of various concepts. The results of Study 4 indicated that merely trying harder did not improve performance on the RAT; however, a mating prime did improve performance, most likely because it enabled superior accessibility to relevant but remote informational links. The results of Studies 1 and 2 are also consistent with the possibility that mating cues enabled better accessibility to various concepts: By having access to a richer set of creative avenues brought about by the romantic primes, people could write stories that were more creative.

Alternative Explanations

The current research has adopted a framework inspired by existing theory regarding sexual and natural selection accounts of creativity (Miller, 2000). It would surely be possible to derive predictions regarding creativity and mating from several other theoretical perspectives, though none seem to offer as straightforward an account of the pattern of results obtained in this series of studies. For example, it

is possible that any vivid fantasy could prime a creative process and lead to an increase in creativity. Thus, for women, perhaps only imagining a high-quality long-term mate may have led to a fantasy that was vivid. However, because both the potential and committed long-term mating primes were very similar to each other but only one of them produced an increase in creativity, this explanation seems unlikely. Not only did both primes produce highly similar mood and arousal for women, but both primes are likely to have produced relatively equally vivid fantasies.

Perhaps an association between creativity and mating arises because of simple mechanisms of associative priming (Srull & Wyer, 1979; see Higgins, 1996 for a review). For example, Chartrand, Fitzsimons, and Fitzsimons (2004) have shown that participants primed with thoughts about Apple computers—a brand marketed as the computer for creative individuals—became more creative compared with people primed with other computer brands. Although priming participants with photos of attractive individuals or romantic scenarios may very well activate concepts of creativity, it is difficult to see how an associative model framework could account for the very specific pattern of sex differences and sex similarities found across the different conditions.

The functional framework used in this research is by no means an alternative to the associative network model of cognition. Both models imply that there are certain links between motivation, cognition, and behavior. However, the functional model does more than just assert that priming specific ideas will lead to the activation of associatively linked semantic and affective categories. Rather, the functional model leads to more finely articulated predictions about how activating specific functional goals should lead to specific goal-consistent—and sex-consistent—cognitive and behavioral responses (Maner et al., 2005).

A social learning model might also suggest that men and women have been differentially rewarded for producing creativity, although it is again difficult to predict the precise prime-specific pattern of sex differences and similarities that we found from this perspective. Further, the final study suggested that tangible rewards actually failed to increase creativity. A social role theory might also posit that it is part of the male role to be creative. However, without a consideration of sex differences in parental investment, it would be difficult for that theory to have predicted a priori why creativity is part of the male role to be creative in all mating contexts but part of the female role to be creative only in committed long-term mating contexts.

Neither social role theories nor social learning theories are mutually exclusive with evolutionary accounts, as evolutionary theorists presume that social roles across societies are to some extent a function of evolved adaptations in men and women and that many behaviors involve an adaptive interplay of learning and evolved predispositions (Kenrick, Trost, & Sundie, 2004; Öhman & Mineka, 2001). We are not aware, however, of social role or social learning theorists who have offered predictions for the pattern of results obtained here—a pattern which follows directly from considerations of sexual selection and parental investment.

Limitations and Future Directions

One of the limitations of the current research is that it did not test whether people become more creative during actual courtship (as suggested by anecdotal evidence). Although future research needs to explore this question, the current framework would predict that the presence of a desirable mate is likely to produce the strongest creative boost, as long as other forces, such as social anxiety, are not working against the display. The current studies also explored only two specific forms of creativity in one culture. However, the proposed evolutionary framework would predict that mating-related cues should spur creativity across cultures, although the specific forms of creativity will surely depend on cultural or local norms (Norenzayan & Heine, 2005; Norenzayan, Schaller, & Heine, in press). Moreover, there may also be multiple person variables that could be used to better predict the display. For instance, mating cues might lead to a boost in people's most favored or best-practiced form of creativity: a musician might become more musically creative, a comedian might be seen as funnier, a poet might be inspired to display verbal fluidity, and a dancer may become more expressive through movement. Future research might also examine why creativity isn't always "turned on" in men as it appears to confer significant benefits. One possibility is that there are costs associated with allocating one's energies to permanent creative displays, such as decreased capacity to attend to other matters or decreased functioning of short-term memory. Another possibility is that there are limitations in most people's abilities to be creative, and that creativity is in a sense a form of "truth in advertising" for a highly functioning brain (see Miller, 2000).

Although the current findings are consistent with a sexual selection account of creativity, these studies were not designed to ascertain whether creativity is an exclusively sexually selected versus naturally selected trait. Indeed, it is often difficult to draw a line between sexual selection and natural selection, partly because mating choices are often based on traits that are themselves naturally selected adaptations (such as symmetrical and healthy feather displays or the ability to fly well in birds). Thus, it is plausible that some more rudimentary form of creativity in humans may have originally evolved because of its association with survival ability (e.g., enhancing ability to create new tools or verbally negotiate one's way out of a conflict). Given that such abilities were adaptive for whatever reason, the members of one sex would have been well served to use them as cues to infer mate value in the other sex. At that point, it would have become useful to display creativity as a courtship tactic. Thus, creativity would be a function of both natural and sexual selection. That is, creativity might provide a survival advantage and function as a heritable fitness indicator (Haselton & Miller, in press). The fact that our research indicates that creativity is likely to be displayed by males across mating contexts, but only selectively by females in contexts associated with quality long-term mates, does suggest, however, that sexual selection plays some role in human creative displays (whatever their ultimate origin).

A larger question pertains to how creativity fits in with other possibly related constructs that may also be in part sexually selected. Although the kinds of creativity measured in the first two studies (story-writing) may be similar to artistic displays, the creativity displayed via the RAT in the latter two studies appears to be more closely related to problem solving rather than artistic ability. From the perspective adopted here, creativity is likely to be related to intelligence (Miller, 2000). In this light, future research might address whether mating motives provide a boost in many types of creative intelligence or perhaps whether only specific forms of creative intelligence are associated with courtship displays. If such displays evolved as fitness indicators, one interesting

possibility is that those individuals who show greater creative boosts in response to mating primes might also be more likely to possess characteristics associated with heritable fitness.

Conclusion

This set of studies began with a puzzling question: Why are muses predominantly women who inspire men? Four experiments indicated that when men merely thought of pursuing a desirable romantic partner, either for a long-term relationship or a short-term fling, such thoughts consistently produced a "muse effect," whereby they boosted male creativity. These findings are consistent with the experiences of Picasso and other male artists who were inspired by female muses. The findings also generally align with the view that creative displays may be linked to sexual selection, which tends to select for more intensive male displays, as witnessed in the courtship tail displays of peacocks. Unlike in peacocks, however, because men often invest heavily in their offspring, women are also subject to sexual selection pressures when it comes to long-term mating. Consistent with parental investment theory, when women were primed with cues designed to instill a desire to attract a high-quality long-term mate, these cues also served to produce a muse effect for women by spurring their creativity.[6]

[6] The renowned Victorian poet Elizabeth Barrett Browning may provide one such example (Winwar, 1950). Mired in artistic mediocrity in her 20s, Elizabeth received a letter from an adoring fan, Robert Browning, who professed his love for her. Not surprisingly, Elizabeth was unconvinced of his intentions until a year—and many of Robert's letters—later, at which point the two lovers agreed to elope in the near-distant future. It was precisely during this phase of her relationship when Elizabeth was inspired to pen *Sonnets from the Portuguese,* which would become her greatest and most critically acclaimed creative work.

References

Amabile, T. M. (1996). *Creativity in context: Update to the social psychology of creativity.* Boulder, CO: Westview.

Andersson, M. (1994). *Sexual selection.* Princeton, NJ: Princeton University Press.

Bargh, J. A. (1990). Auto-motives: Preconscious determinant of social interaction. In E. T. Higgins & R. M. Sorrentino (Eds.), *Handbook of motivation and social cognition: Foundations of social behavior* (Vol. 2, pp. 93–130). New York: Guilford Press.

Bargh, J. A., & Chartrand, T. L. (1999). The unbearable automaticity of being. *American Psychologist, 54,* 464–479.

Borgia, G. (1986). Sexual selection in bowerbirds. *Scientific American, 254,* 92–100.

Borgia, G. (1995). Complex male display and females choice in the spotted bowerbird: Specialized functions for different bower decorations. *Animal Behavior, 49,* 1291–1301.

Bowden, E. M., & Beeman, M. J. (1998). Getting the right idea: Semantic activation in the right hemisphere may help solve insight problems. *Psychological Science, 9,* 435–440.

Bowden, E. M., & Beeman, M. J. (2003). Normative data for 144 compound remote associate problems. *Behavior Research Methods, Instruments, and Computers, 35,* 634–639.

Bugental, D. B. (2000). Acquisition of the algorithms of social life: A domain-based approach. *Psychological Bulletin, 126,* 187–219.

Buss, D. M. (2005). *Evolutionary psychology: The new science of the mind* (2nd ed.). Boston: Allyn & Bacon.

Buss, D. M., & Barnes, M. (1986). Preferences in human mate selection. *Journal of Personality and Social Psychology, 50,* 559–570.

Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100,* 204–232.

Byrne, R. (1995). *The thinking ape: Evolutionary origins of intelligence.* Oxford, United Kingdom: Oxford University Press.

Chartrand, T. L., & Bargh, J. A. (1996). Automatic activation of impression formation and memorization goals: Nonconscious goal priming reproduces effects of explicit task instructions. *Journal of Personality and Social Psychology, 71,* 464–478.

Chartrand, T. L., Fitzsimons, G. M., & Fitzsimons, G. J. (2004, February). *The effects of priming anthropomorphized objects on behavior*. Paper presented at the meeting for the Society for Personality and Social Psychology, Austin, TX.

Cosmides, L., & Tooby, J. (1992). Cognitive adaptations for social exchange. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind* (pp. 163–228). Oxford, United Kingdom: Oxford University Press.

Crespelle, J. P. (1969). *Picasso and his women.* New York: Hodder & Stoughton.

Cronin, H. (1993). *The ant and the peacock: Altruism and sexual selection from Darwin to today.* New York: Cambridge University Press.

Darwin, C. (1981). *The descent of man, and sexual selection in relation to sex* (Vols. 1 & 2). Princeton, NJ: Princeton University Press (Original work published 1871)

Eysenck, H. J. (1995). *Genius: The natural history of creativity.* Cambridge, United Kingdom: Cambridge University Press.

Gangestad, S. W., Haselton, M. G., & Buss, D. M. (in press). Evolutionary foundations of cultural variation: Evoked culture and mate preferences. *Psychological Inquiry.*

Gangestad, S. W., & Simpson, J. A. (2000). On the evolutionary psychology of human mating: Trade-offs and strategic pluralism. *Behavioral and Brain Sciences, 23,* 573–587.

Geary, D. C. (2000). Evolution and proximate expression of human paternal investment. *Psychological Review, 126,* 55–77.

Geissmann, T. (2000). Duet songs of the siamang, *Hylobates syndactylus*: I. Structure and organisation. *Primate Report, 56,* 33–60.

Gibson, K. R., & Ingold, T. (Eds.). (1993). *Tools, language, and cognition in human evolution.* Cambridge, United Kingdom: Cambridge University Press.

Griskevicius, V., Goldstein, N. J., Mortensen, C. R., Cialdini, R. B., & Kenrick, D. T. (in press). Going along versus going alone: When fundamental motives facilitate strategic (non)conformity. *Journal of Personality and Social Psychology.*

Gutierres, S. E., Kenrick, D. T., & Partch, J. J. (1999). Beauty, dominance, and the mating game: Contrast effects in self-assessment reflect gender differences in mate selection. *Personality & Social Psychology Bulletin, 25,* 1126–1134.

Hamann, S., Herman, R. A., Nolan, C. L., & Wallen, K. (2004). Men and women differ in amygdala response to visual sexual stimuli. *Nature Neuroscience, 7,* 411–416.

Haselton, M. G., & Buss, D. M. (2000). Error management theory: A new perspective on biases in cross-sex mind reading. *Journal of Personality and Social Psychology, 78,* 81–91.

Haselton, M. G., & Miller, G. F. (in press). Women's fertility across the cycle increases the short-term attractiveness of creative intelligence compared to wealth. *Human Nature.*

Higgins, E. T. (1996). Knowledge activation: Accessibility, applicability, and salience. In E. T. Higgins & A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp. 133–168). New York: Guilford Press.

Hrdy, S. B. (1999). *Mother nature: Maternal instincts and how they shape the human species.* New York: Ballantine Books.

Hurtado, A. M., Hill, K., Kaplan, H., & Hurtado, I. (1992). Trade-offs

between female food acquisition and child care among Hiwi and Ache foragers. *Human Nature, 3,* 185–216.

Kanazawa, S. (2000). Scientific discoveries as cultural displays: A further test of Miller's courtship model. *Evolution and Human Behavior, 21,* 317–321.

Kenrick, D. T., Li, N. P., & Butner, J. (2003). Dynamical evolutionary psychology: Individual decision-rules and emergent social norms. *Psychological Review, 110,* 3–28.

Kenrick, D. T., Sadalla, E. K., Groth, G., & Trost, M. R. (1990). Evolution, traits, and the stages of human courtship: Qualifying the parental investment model. *Journal of Personality, 58,* 97–117.

Kenrick, D. T., Sadalla, E. K., & Keefe, R. C. (1998). Evolutionary cognitive psychology: The missing heart of modern cognitive science. In C. Crawford & D. L. Krebs (Eds.), *Handbook of evolutionary psychology* (pp. 485–514). Hillsdale, NJ: Erlbaum.

Kenrick, D. T., Trost, M. R., & Sundie, J. M. (2004). Sex-roles as adaptations: An evolutionary perspective on gender differences and similarities. In A. H. Eagly, A. Beall, & R. Sternberg (Eds.), *Psychology of gender* (pp. 65–91). New York: Guilford Press.

Kerr, G., & Gagliardi, C. (2004). *Measuring creativity in research and practice.* Unpublished manuscript, Arizona State University, Tempe.

Kingdon, J. (1993). *Self-made man and his undoing.* New York: Simon & Schuster.

Levin, J. R., & Neumann, E. (1999). Testing for predicted patterns: When interest in the whole is greater than the sum of its parts. *Psychological Methods, 4,* 44–57.

Li, N. P., Bailey, J. M., Kenrick, D. T., & Linsenmeier, J. A. (2002). The necessities and luxuries of mate preferences: Testing the trade-offs. *Journal of Personality and Social Psychology, 82,* 947–955.

MacGregor-Hastie, R. (1988). *Picasso's women.* London: Lennard Publishing.

Maner, J., Kenrick, D., Becker, D., Robertson, T., Hofer, B., Neuberg, S., et al. (2005). Functional projection: How fundamental social motives can bias interpersonal perception. *Journal of Personality and Social Psychology, 88,* 63–78.

Mednick, S. A. (1962). The associative basis of the creative process. *Psychological Review, 69,* 220–232.

Miller, G. F. (1999). Sexual selection for cultural displays. In R. Dunbar, C. Knight, & C. Power (Eds.), *The evolution of culture* (pp. 71–91). Edinburgh, United Kingdom: Edinburgh University Press.

Miller, G. F. (2000). *The mating mind: How sexual choice shaped the evolution of human nature.* New York: Doubleday.

Møller, A. P., & Petrie, M. (2002). Condition dependence, multiple sexual signals, and immunocompetence in peacocks. *Behavioral Ecology, 13,* 248–253.

Norenzayan, A., & Heine, S. J. (2005). Psychological universals across cultures: What are they and how do we know? *Psychological Bulletin, 131,* 763–784.

Norenzayan, A., Schaller, M., & Heine, S. J. (in press). Evolution and culture. In M. Schaller, J. Simpson, & D. Kenrick (Eds.), *Evolution and social psychology.* New York: Psychology Press.

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review, 108,* 483–522.

Peplau, L. A. (2003). Human sexuality: How do men and women differ? *Current Directions in Psychological Science, 12,* 37–40.

Pinker, S. (1997). *How the mind works.* New York: Norton.

Prose, F. (2002). *The lives of the muses: Nine women and the artists they inspired.* New York: Harper Collins Publishers.

Raemaekers, J. J., & Raemaekers, P. M. (1984). Vocal interactions between two male gibbons, *Hylobates lar. Natural History Bulletin of the Siam Society, 32,* 95–106.

Roney, J. R. (2003). Effects of visual exposure to the opposite sex: Cognitive aspects of mate attraction in human males. *Personality and Social Psychology Bulletin, 3,* 393–404.

Schaller, M. (2003). Ancestral environments and motivated social perception: Goal-like blasts from the evolutionary past. In S. J. Spencer, S. Fein., M. P. Zanna, & J. M. Olson (Eds.), *Motivated social perception* (pp. 215–231). Mahwah, NJ: Erlbaum.

Schaller, M., Faulkner, J., Park, J. H., Neuberg, S. L., & Kenrick, D. T. (2004). Impressions of danger influence impressions of people: An evolutionary perspective on individual and collective cognition. *Journal of Cultural and Evolutionary Psychology, 2,* 231–247.

Schooler, J. W., & Melcher, J. (1995). The ineffability of insight. In S. M. Smith, T. B. Ward, & R. A. Finke (Eds.), *The creative cognition approach* (pp. 249–268). Cambridge, MA: MIT Press.

Scott, J. P. (1980). The function of emotions in behavioral systems: A systems theory analysis. In R. Plutchik & H. Kellerman (Eds.), *Emotion: Theory, research, and experience* (Vol. 1). New York: Academic Press.

Simonton, D. K. (2000). Creativity: Cognitive, personal, developmental, and social aspects. *American Psychologist, 55,* 1.

Simpson, J. A., & Gangestad, S. W. (1991). Individual differences in sociosexuality: Evidence for converging and discriminant validity. *Journal of Personality and Social Psychology, 67,* 870–883.

Simpson, J. A., & Gangestad, S. W. (1992). Sociosexuality and romantic partner choice. *Journal of Personality, 60,* 31–51.

Srull, T. K., & Wyer, R. S. (1979). The role of category accessibility in the interpretation of information about persons: Some determinants and implications. *Journal of Personality and Social Psychology, 37,* 1660–1672.

Sternberg, R. J., & Lubart, T. I. (1999). The concept of creativity: Prospects and paradigms. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 3–15). Cambridge, United Kingdom: Cambridge University Press.

Todd, P. M., & Gigerenzer, G. (2000). Precis of "simple heuristics that make us smart." *Behavioral & Brain Sciences, 1,* 727–780.

Trivers, R. L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man: 1871–1971* (pp. 136–179). Chicago: Aldine.

Wilson, M., & Daly, M. (2004). Do pretty women inspire men to discount the future? *Proceedings of the Royal Society, Series B, 271*(Suppl. 4), 177–179.

Winwar, F. (1950). *The immortal lovers: Elizabeth Barrett & Robert Browning; a Biography.* New York: Harper.

Zahavi, A., & Zahavi, A. (1997). *The handicap principle: A missing piece of Darwin's puzzle.* New York: Oxford University Press.

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