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Sex differences in human jealousy
A coordinated study of forced-choice, continuous rating-scale, and physiological responses on the same subjects

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Abstract

Previous investigators have confirmed the evolutionary hypothesis that the sexes differ in their responses to sexual vs. emotional infidelity and have taken their results as suggesting the existence of a mechanism that regulates the perceptions of threat, the emotional responses, and the physiological reactions that constitute jealousy. This notion implies that these three categories of response should occur systematically in the same group of subjects. However, no study has been done to confirm this implication. This study is the first to demonstrate the traditional findings concerning these three categories of response on the same group of subjects. Overall, the results of this investigation are consistent with the core evolutionary hypothesis of sex differences in human jealousy.

Keywords: Human jealousy; Sex differences; Emotions; Psychophysiology

1. Introduction

One of the most widely disseminated conclusions of evolutionary psychological research is that male and female jealousy is inspired by different threats (Buss et al., 1999; Buunk,

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Angleitner, Oubaid, & Buss, 1996; Symons, 1979). While male jealousy is more likely to be inspired by threats of sexual infidelity, female jealousy is more likely to be inspired by threats of emotional infidelity (Buss, Larsen, Westen, & Semmelroth, 1992; Buunk et al., 1996; Wiederman & Allgeier, 1993). Such sex differences have been observed in the United States (Buss et al., 1992; Buunk et al., 1996; DeSteno & Salovey, 1996; Harris & Christenfeld, 1996), the Netherlands, Germany, Korea, Japan (Buunk et al., 1996), and Sweden (Wiederman & Kendall, 1999). According to Buss (1994), sex differences in the eliciting factors of human jealousy are probably a human universal.

The evidence that supports this conclusion arises from three kinds of studies: (1) forced-choice studies in which men and women are asked which sort of situation — sexual infidelity or emotional infidelity — they would find most upsetting (Bailey, Gaulin, Agyei, & Gladue, 1994; Buss et al., 1992; Buunk et al., 1996; DeSteno & Salovey, 1996; Harris & Christenfeld, 1996; Wiederman & Allgeier, 1993); (2) continuous rating-scale studies in which men and women are asked to report their emotional reactions in response to the two sorts of situations (deWeerth & Kalma, 1993; Geary, Rumsey, Bow-Thomas, & Hoard, 1995; Shackelford, LeBlanc, & Drass, 2000); and (3) physiological response studies, in which several physiological variables of male and female subjects are tracked as they imagine the two sorts of jealousy-inducing situations (Buss et al., 1992; Harris, 2000). These studies have typically included variables thought to reflect an individual's defensive and/or aggressive responses to relationship threats and have included (1) heart (pulse) rate (HR), (2) electrodermal (palm sweating) activity (EDA), (3) electromyographic (frowning) activity of the forehead muscle (EMG), and (4) systolic and diastolic blood pressure (BP).

In her concise commentary on the evolutionary psychological literature on jealousy, Harris (2000) has raised doubts about the relationship between the widely disseminated conclusion and the purported evidence for it. She pointed out that in the forced-choice procedure, while men and women universally vary in the proportions that would be more upset by sexual infidelity than by emotional infidelity, different studies report different proportions. For example, while a clear majority of women report that they would be more distressed by emotional infidelity, ranging from approximately 62% (DeSteno & Salovey, 1996) to 86% (Buss et al., 1992), only a slight majority of men reported that they would be more bothered by sexual infidelity, ranging from 47% (Harris & Christenfeld, 1996) to 60% (Buss et al., 1992).

From her review of studies that have employed continuous rating-scales, Harris (2000) concludes that sex differences implied by the forced-choice studies are not always confirmed. For example, deWeerth and Kalma (1993) found that more women than men reported that they would verbally or physically aggress against a rival or a mate in response to sexual betrayal. Moreover, in two additional studies, male and female college students who had experienced a mate's infidelity did not significantly differ in their assessment of how damaging sexual infidelity was to their sexual relationship (Hansen, 1987), or in their amount of focus on the sexual and emotional aspects of the infidelity (Harris, 2000).

Similarly, with respect to Buss et al.'s (1992) physiological results, Harris (2000) reminds us that only one out of Buss et al.'s three attempted measures (EDA) showed a significant

difference between male and female physiological response and that women did not show much autonomic reactivity while imagining either infidelity scene. In an attempt to replicate these results, Harris found no evidence to support the evolutionary psychological model of female jealousy. She found that while male HR and BP increased while imagining sexual infidelity, female physiological response elicited while imagining emotional infidelity was not significantly greater than that elicited while imagining sexual infidelity. Harris concludes that neither the rating-scale studies nor the physiological studies consistently confirm the conclusions so often drawn from forced-choice studies. In her opinion, these ambiguities cast doubt on whether male and female jealousy constitutes a sexually and situationally differentiated response system.

One possible source of these ambiguities is that the three types of evidence for the sexual differentiation of jealousy have been collected from different groups of subjects. Thus, the inconsistency in the outcomes can be plausibly attributed to differences in the conditions of the various studies rather than to an incoherence of the system underlying the responses in the three kinds of studies. Thus, one goal of the present study was to replicate the three kinds of findings in the same experimental procedure on the same group of subjects in the hope of demonstrating that the same subjects that show a sexually differentiated response to jealousy scenarios in the forced-choice paradigm also show differentiated continuous rating-scale ratings and physiological responses.

The present study makes use of the following physiological measures: HR, EDA, EMG, and skin temperature (TEMP). Because HR and EDA measurements were used in both the Buss et al. (1992) and Harris (2000) studies, we employ them in attempt to replicate these results. Moreover, since Buss et al. did not find a significant sexually differentiated response in frowning (EMG) activity, the present study makes use of this measure to further investigate the nature of frowning in response to sexual and emotional infidelity. Finally, TEMP, a measure never before used in assessing physiological responses associated with jealousy, is also measured in order to detect subtle changes in sympathetic activation (see Hugdahl, 1995).

Another goal of this study is to clarify an ambiguity in the literature made salient by Harris's (2000) critique. The literature has been unclear as to whether jealousy is sexually differentiated in that it is elicited by different features of the jealousy situation in members of the two sexes (*situational* differentiation) and/or differentiated in that the two sexes are disposed to respond in different ways when jealous (*response* differentiation). To the extent that emotion rating systems and physiological responses reflect dispositions to action, some findings (e.g., Buss et al., 1992; Geary et al., 1995) seem to suggest that male and female jealousy is situationally differentiated. For instance, Buss et al. (1992) found that with respect to measures of EDA, men and women responded similarly in response to the type of infidelity that distressed them the most — sexual infidelity for men, emotional infidelity for women. In contrast, other findings (e.g., Buss et al., 1992; Geary et al., 1995; Shackelford et al., 2000; Shettel-Neuber, Bryson, & Young, 1978) seem to suggest that males and females respond in different ways to the situations that make them jealous (i.e., their behavior is response differentiated). For example, Shettel-Neuber et al. (1978) had students view a jealousy scenario on videotape and asked them to describe their probable

actions if they were involved in the situation. Men considered themselves more likely to become angry, drunk, and threatening, while women considered themselves more likely to cry and to feign indifference. Finally, Shackelford et al. (2000) found that relative to men, women rated themselves more Helpless/Abandoned and Shocked for both types of infidelity, but that the mean sex differences were greater for emotional than for sexual infidelity. In contrast, men's ratings of Homicidal/Suicidal were higher than women's ratings for both types of infidelity, with the mean sex difference greater for emotional than for sexual infidelity.

We hope that an examination of the effects of all three procedures on the same subjects may help to clarify the manner in which male and female jealousy is sexually differentiated.

2. Method

2.1. Subjects

Subjects were 47 undergraduate students, 25 female and 22 male, 18–23 years of age ($M = 20.4$), each volunteering to complete a 30-min laboratory session.

2.2. Measures

The experiment employed three different types of measures: the forced-choice question, continuous (emotional) rating-scale responses, and physiological measures.

2.2.1. Forced-choice question

Each participant was presented with a questionnaire that included the following dilemmas (adapted from Buss et al., 1992), presented in counterbalanced order between subjects:

> Please think of a committed romantic relationship that you have had in the past, that you have now, or that you would like to have. Imagine that you discover that the person with whom you have been seriously involved becomes interested in someone else. What would upset or distress you more? (Please circle only one.)
>
> (A) Discovering that your partner is having deep passionate sex with that other person, trying out sexual positions you had only dreamed about.
>
> (B) Discovering that your partner is forming a deep emotional attachment by confiding and sharing confidences with that other person.

2.2.2. Physiological measures

Physiological activity was monitored and measured using Thought Technology BioGraph V1.01 Software and ProComp+ Hardware and was based on the observation that pulse rate, EDA, and increases in skin temperature are indicators of sympathetic activation of the autonomic nervous system (Ekman & Friesen, 1978; Hugdahl, 1995; Levenson, 1988). Finally, in accordance with Buss et al. (1992), because distress is understood as an unpleasant subjective state, electromyographic activity was measured over the *corrugator supercilli*

muscle, which is responsible for the furrowing of the brow often seen in facial displays of unpleasant emotion or affect (Fridlund, Ekman, & Oster, 1987).

2.2.2.1. Pulse rate. The HR/BVP-Flex/Pro Sensor (SA9308P) photoplethysmograph was attached to the padded portion of the thumb (palmar side) of the subject's nondominant (nonwriting) hand to monitor the pulse wave.

2.2.2.2. Peak EDA. The Skin Conductance-Flex/Pro Sensor (SA9309P) was fitted with Standard Beckman Ag/AgCl surface electrodes and coated with a 0.05-M NaCl solution in a Unibase paste. The electrodes were placed over the middle (medial phalanx) palmar segments of the first (index) and second (middle) fingers of the subject's nondominant (nonwriting) hand.

2.2.2.3. Surface electromyographic activity. Bipolar EMG recordings were obtained over the *corrugator supercilii* muscle. The active electrodes of the MyoScan Pro Sensor (T9401P-60) were placed parallel to the fibers of the *corrugator supercilii* muscle to ensure proper detection and measurement of amplified myographic activity.

2.2.2.4. Skin temperature. The Temperature-Flex/Pro Sensor (SA9310P) 125 in. thermistor was positioned on the palmar, padded portion of the subject's nondominant (nonwriting) hand. An elastic strap was lightly tightened over the sensor to ensure constant thermistor-to-skin contact. Temperatures were recorded only from 12 female and 10 male subjects.

2.2.3. Emotion rating-scale

A Likert-type emotion rating-scale was used to quantify the strength of emotions experienced during each of the infidelity scenarios. This scale consisted of an emotion-rating visual analogue scale adopted from Plutchik (1980). Subjects described their feelings by making a mark on each of nine linear scales, labeled "Anger," "Rage," "Humiliation," "Pain," "Fear," "Humiliation," "Anxiety," "Depression," and "Betrayal." Only the end points of the line were labeled as "Do not feel at all" and "Feel very strongly." The responses were scored in quarter-inch increments. The possible range of response was 1–13.

2.3. Procedure

Experimental procedures were adapted from Buss et al. (1992). Two experimenters carried out the experimental sessions. Upon arrival, each participant was greeted and was handed a consent form, which described the procedure in detail. Two rooms separated by one-way glass were used to allow subjects to be alone and comfortable in the experimental room during the imagery sessions. An intercom was used for verbal communication between the two rooms. The instructions for each of the imagery tasks — neutral, and in counterbalanced order, sexual infidelity and emotional infidelity — were typewritten on separate forms, which the subject was directed to read and follow. After participants gave their consent, they were made comfortable in a reclining chair and the psychophysiological apparatus was attached to them.

Following the recommendations of Jennings et al. (1981), a 1-min baseline physiological measurement was taken. Each participant was then instructed to engage in three separate imagery scenarios. The first image was designed to be emotionally neutral:

Imagine a time when you were walking to class, feeling neither good nor bad, just neutral.

The participant was instructed to press a button when he or she had the image clearly in mind, and to sustain the image until the experimenter said to stop. The button triggered the computer to begin the physiological data recording for a 20-s period, after which the experimenter told the participant to "stop and relax." The relaxation period lasted for 1 min. Each participant was then instructed to engage in two infidelity images, in counterbalanced order, one sexual and one emotional. The instructions for both infidelity images follow from Buss et al. (1992). The instructions for sexual infidelity imagery were as follows:

> Please think of a serious romantic relationship that you have had in the past, that you currently have, or that you would like to have. Now imagine that the person with whom you're seriously involved becomes interested in someone else.
>
> *Imagine you find out that your partner is having sexual intercourse with this other person. Try to feel the feelings you would have if this happened to you.*

The instructions for emotional infidelity imagery were identical to the above, except the italicized sentence was replaced with:

> *Imagine that your partner is falling in love and forming an emotional attachment to that person.*

Upon the participant's pressing of the button — an indication that the participant had formed and was sustaining an image of the infidelity scenario — physiological data was recorded for 20 s. To control for any confounding physiological activity, participants were told to "stop and relax" for 1 min between imagery trials. During this period, participants completed a continuous rating-scale specific for either sexual or emotional infidelity. Finally, the psychophysiological apparatus was removed and each participant completed a questionnaire, which consisted of the forced-choice question and information regarding age and sex.

2.4. Statistical tests

All measures were averaged over 20-s imagery trials consisting of neutral imagery, and, in counterbalanced order, sexual infidelity imagery and emotional infidelity imagery. Magnitudes of physiological responses for the sexual and emotional infidelity imagery trials were compared by two-way ANOVAs with sex of subjects as a between-subjects factor, and sexual infidelity and emotional infidelity as within-subjects factors. These analyses utilized the multivariate solution because of the likelihood of violations of assumptions regarding sphericity and compound symmetry (Tabachnick & Fidell, 2001). Interactions of sex with infidelity imagery, the results of primary interest, were examined using planned comparisons.

Magnitudes of self-reported emotional responses to sexual and emotional infidelity scenarios were compared in two-way ANOVAs with sex of subjects as a between-subjects

factor, and sexual infidelity and emotional infidelity as within-subjects factors. Interactions of sex with infidelity imagery, the results of primary interest, were examined using planned comparisons.

3. Results

All three measures, the forced-choice question, the continuous rating-scale responses, and the physiological recordings, produced sexually differentiated responses in our subjects.

3.1. Forced-choice question

As expected, male and female subjects differed in the frequencies of responses to sexual and emotional infidelity scenarios ($\chi^2 = 23.941$, $df = 1$, $P < .001$). Whereas 73% of the male sample reported greater distress over their partner's potential sexual infidelity, only 4% of the female sample selected that option. Of the female sample, 96% reported that they would experience greater distress over a partner's emotional attachment to a rival female; 27% of males reported that they would experience greater distress over emotional infidelity.

3.2. Continuous rating-scale responses

Significant interactions between sex and type of imagined infidelity were found for anger, rage, anxiety, and betrayal [F's(1,45) > 5.25, P's < .05]. No significant interactions were found for ratings of pain, fear, depression, and humiliation [F's(1,45) < 1.73, P's>.18]. Planned comparisons, shown in Table 1, indicated that men reported a significantly stronger experience of anger ($P < .001$), rage ($P < .001$), and betrayal ($P < .01$) while imagining sexual infidelity than while imagining emotional infidelity. Women reported a significantly stronger experience of anger ($P < .01$), anxiety ($P < .02$), and fear ($P < .04$) while imagining emotional infidelity than while imagining sexual infidelity.

Table 1
Means and S.E.M.'s of emotion ratings for sexual infidelity and emotional infidelity imagery *

	Type of infidelity imagery			
	Sexual		Emotional	
Emotion	Male	Female	Male	Female
Anger	9.82 ± 0.74^a	7.76 ± 0.62^b	6.77 ± 0.88^a	10.28 ± 0.59^b
Rage	8.68 ± 0.85^a	7.88 ± 0.66	4.73 ± 0.87^a	8.96 ± 0.66
Anxiety	7.50 ± 0.97	7.48 ± 0.90^a	6.27 ± 0.96	9.76 ± 0.65^a
Betrayal	10.91 ± 0.71^a	10.08 ± 0.65	8.27 ± 0.86^a	10.16 ± 0.63
Fear	5.86 ± 1.02	6.72 ± 0.89^a	7.00 ± 0.99	9.00 ± 0.82^a

* Within emotions, means with the same superscripts differ significantly, $P < .04$.

Table 2
Means and S.E.M.'s of physiological measures for neutral, sexual infidelity, and emotional infidelity imagery *

	Type of imagery					
	Neutral		Sexual infidelity		Emotional infidelity	
Measure	Male	Female	Male	Female	Male	Female
HR (bpm)	78.61 ± 2.96^{a}	88.18 ± 3.12^{b}	$84.70 \pm 2.79^{a,c}$	84.51 ± 4.07^{d}	78.67 ± 2.59^{c}	$91.50 \pm 2.86^{b,d}$
EDA (μmhos)	8.97 ± 1.05^{a}	10.36 ± 1.44	$10.25 \pm 1.24^{a,b}$	10.05 ± 1.24^{c}	9.69 ± 1.20^{b}	10.71 ± 1.24^{c}
EMG (μV)	4.81 ± 0.82^{a}	6.27 ± 0.92^{b}	$9.11 \pm 1.18^{a,c}$	5.70 ± 0.81^{d}	4.55 ± 0.85^{c}	$9.01 \pm 0.96^{b,d}$
TEMP (°F)	80.87 ± 1.90	82.98 ± 1.50	81.60 ± 1.82^{a}	82.33 ± 1.57^{b}	80.66 ± 2.05^{a}	83.51 ± 1.63^{b}

* Within measures, means with the same superscripts differ significantly, $P < .04$.

3.3. Physiological responses

As predicted, male response patterns differed from females' on all physiological measures: for HR, peak EDA and EMG [F's(1,45)>11.44, P's < .001], and for TEMP [$F(1,20) = 18.82$, $P < .001$]. Planned comparisons, shown in Table 2, indicated that men were more responsive to sexual infidelity than to emotional infidelity for HR ($P < .02$), peak EDA ($P < .01$), EMG ($P < .01$), and TEMP ($P < .01$). Relative to measures obtained during neutral imagery, men demonstrated increased HR ($P < .03$), peak EDA ($P < .01$), and EMG ($P < .0001$) during sexual infidelity imagery. Women were significantly more responsive to emotional infidelity than to sexual infidelity for HR ($P < .005$), peak EDA ($P < .01$), EMG ($P < .001$), and TEMP ($P < .04$). Relative to measures obtained during neutral imagery, women demonstrated increased HR ($P < .01$) and EMG ($P < .0001$) during emotional infidelity imagery.

4. Discussion

This study demonstrates that men and women who show sexually differentiated responses to jealousy scenarios on the forced-choice situation also show sexually differentiated continuous rating-scale and physiological responses. The subjects in this study robustly displayed sexually differentiated responses to sexual vs. emotional infidelity in the forced-choice situation, in their ratings on the continuous scales, and in their physiological responses. Men were more often upset by imagining sexual infidelity and women by imagining emotional infidelity, and both men and women reported feeling more angry in response to the situation that upset them the most — sexual infidelity for men, emotional infidelity for women.

The results of the current study are mostly consistent with situational differentiation, but some are consistent with the alternative, response differentiation (see Table 3). For instance, ratings of anger were found to be situationally differentiated, suggesting that both men and women become angry in response to the type of infidelity or situation that they find most distressing. This evidence suggests that anger may be a general (i.e., situationally differentiated) emotional reaction to a jealousy-evoking situation (confirming Geary et al., 1995). Physiological results suggest that male and female autonomic responses are also situationally

Table 3
Situational and response differentiation results for emotion rating-scale and physiological response data

Situational differentiation	Response differentiation
Continuous rating-scale responses	
Men	
Anger**	Rage***
	Betrayal*
Women	
Anger**	Anxiety*
	Fear*
Physiological measures	
Men	
HR*	None
EDA**	
EMG**	
TEMP**	
Women	
HR**	None
EDA**	
EMG***	
TEMP*	

* $P < .05$.
** $P < .01$.
*** $P < .001$.

differentiated. These findings provide the most unambiguous demonstration to date that generalized autonomic arousal is elicited in response to different types of relationship threats in men and women.

Response differentiation is evident on continuous rating-scale measures of rage, betrayal, anxiety, and fear (see Table 3). While men reported feeling more rage and betrayal while imagining sexual infidelity, women reported feeling more anxiety and fear while imagining emotional infidelity. This evidence suggests that whereas rage and betrayal are characteristic male responses to sexual infidelity, anxiety and fear are characteristic female responses to emotional infidelity. These response-differentiated reactions suggest that these specific emotional responses may be characteristic responses of the sexes to the different types of infidelity threats.

The strong consistency of these results may speak to the importance of examining all three procedures on the same group of subjects. Before the current experiment, no one, including Harris (2000), had ever performed the three procedures on the same subjects. As a result, some of the variability in previous outcomes may have been caused by variations in subject populations and procedures. By performing the three procedures on the same subjects in the present study, we were able to examine the coherence of the responses that appear to characterize sexually differentiated jealousy response systems. By the same token, this feature of the procedure limits our conclusions only to our current subject pool, college

students from a largely middle-class US student body. Before these conclusions can be more widely generalized, the procedures would have to be replicated on samples drawn from other subject pools.

These results go a long way in assuaging Harris's doubts about the relation between available evidence and the notion of sexually differentiated jealousy response systems. For example, with respect to studies that employed the forced-choice procedure, Harris contends that while a clear majority of women (62–82%) chose emotional infidelity as most distressing, only a slight majority (47–60%) of men chose sexual infidelity as most distressing. The present study found moderately stronger results, with 96% of women reporting emotional infidelity as most distressing and 73% of men reporting sexual infidelity as most distressing. These differences for both women and men are greater than previous findings and offer evidence of robust sexual differentiation on the forced-choice procedure in our sample and to this extent support the evolutionary claim that women should be more distressed by emotional infidelity, men by sexual infidelity.

Harris also takes issue with Buss et al.'s (1992) physiological results, claiming that sexual differentiation on their measures of HR, EDA, and EMG was not clear and that while these authors found that men were more responsive to sexual infidelity, the magnitudes of women's responses to emotional infidelity were much weaker. The present study, following Buss et al.'s procedure, found substantial sexual differentiation on all measures attempted by them — HR, EDA, EMG — and on a new measure, TEMP. Contrary to Harris's (2000) finding, women in the current study showed increased autonomic reactivity on all physiological measures while imagining emotional infidelity, an observation consistent with Buss et al.'s initial hypothesis. These physiological results confirm the pattern of sexual differentiation so often found in forced-choice studies (e.g., Bailey et al., 1994; Buss et al., 1992; DeSteno & Salovey, 1996; Harris & Christenfeld, 1996; Wiederman & Allgeier, 1993).

The present study also helps clarify a putative challenge to the evolutionary theory of sex differences in human jealousy. Some researchers (DeSteno & Salovey, 1996; Harris & Christenfeld, 1996) have inferred less sexually differentiated responses, suggesting that sexual infidelity implies that an emotional infidelity has taken place and vice versa. However, in comparisons with the neutral imagery conditions in the present study, men did not show any evidence of a significant physiological response to emotional infidelity and women did not show any evidence of significant physiological response to sexual infidelity. This observation suggests that a man's response to sexual infidelity is not in part a response to implied emotional infidelity nor is a woman's response to emotional infidelity in part a response to implied sexual infidelity.

To the extent that Harris's (2000) objections are empirically based, these results could be seen as supporting Buss et al.'s (1992) notion of a specific jealousy response system. However, the bulk of Harris's objections seem to be based on the potential confoundings produced by the absence of critical controls in the jealousy literature. Strictly speaking, for an experiment to be taken as supporting a specific jealousy response system, control groups would have to include subjects responding to other emotional stimuli in addition to neutral imagery. Harris, herself, provides an example of such a control group — males imagining sexual imagery without infidelity. Harris' inability to distinguish between men's responses to

sexual imagery and sexual infidelity imagery is indeed worrying for anyone who believes that jealousy is a distinct response system. Thus, while we think our experiment provides solid support for sexual differentiation of responses to jealousy scenarios, its implications for the theoretical notion of a specific jealousy response system must await systematic research with carefully devised control groups.

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