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Original Article

Sex Differences in Implicit Association and Attentional Demands for Information about Infidelity[1]

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Abstract: Sex differences in reaction to a romantic partner's infidelity are well documented and are hypothesized to be attributable to sex-specific jealousy mechanisms that solve sex specific adaptive problems. There have been few cognitive-based investigations of jealousy, however. Here we investigated sex differences in implicit processing of jealousy-based information. In Experiment 1, we used the implicit association test (IAT) to investigate sex-differentiated biases in classifying sexual or emotional infidelity information as being positive or negative. Men made significantly more errors when asked to classify as pleasant, words indicating sexual infidelity. In Experiment 2, we modified the Stroop task to include words that depicted infidelity-related topics in three priming conditions: sexual infidelity priming, emotional infidelity priming, and a no priming control. Men were significantly slower to respond after being primed with sexual infidelity scenarios. The effect of sexual infidelity priming was not word-category specific, suggesting that cognition about a partner's sexual infidelity hijacks general cognitive and attentional processing. These findings suggest that men may automatically classify information about sexual infidelity as negative and that the automatic negative processing of sexual infidelity takes precedent over other types of immediate cognition.

Keywords: jealousy, infidelity, sex differences, sexual infidelity, emotional infidelity, Stroop, and Implicit Association Test

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Introduction

Jealousy is a leading cause of female-directed intimate partner abuse, rape, and homicide (Daly and Wilson, 1988; Shackelford and Goetz, 2006). About 1.5 million women are raped or physically assaulted by an intimate partner each year in the United States and 8% of women report having been stalked by an intimate partner at some point in their lives (Tjaden and Thoennes, 1998a; 1998b). It has been hypothesized that men's jealous, controlling and sometimes violent behavior may have evolved to prevent or punish a partner's defection from the relationship (see Buss, 2002, for review).

Humans engage in "social monogamy," whereby males and females form partnerships and cooperate to raise offspring. Social monogamy may have evolved in humans because of the need for bi-parental investment in altricial offspring. Social monogamy does not imply genetic monogamy, however. In fact, genetic monogamy is the exception rather than the rule in the animal kingdom (e.g., Morell, 1998). Social monogamy has been defined by Gillette, Jaeger, and Peterson (2000, p.1241), "as occurring when two heterosexual adults, exclusive of kin directed behavior, direct significantly less aggression and significantly more submission towards each other, and/or spend significantly more time associating with each other relative to other adult heterosexual conspecifics." In humans, social monogamy typically leads to marriage. Today, marriage is prevalent in every known culture and so, too, is infidelity (Anderson, 2006; Bellis, Hughes, Hughes and Ashton, 2005; Brown, 1991; Epstein and Guttman, 1984; Platek and Shackelford, 2006; Shackelford, LeBlanc and Drass, 2000; Vandenberg, 1972).

The occurrence of human extra-pair paternity varies widely, from 1-30%, with the best estimate near 10% (Anderson 2006; Bellis et al., 2005; Baker and Bellis, 1995; Cerda-Flores, Barton, Marty-Gonzales, Rivas and Chakbroty, 1999; Neale, Neale, and Sullivan, 2002; Sasse, Muller, Chakbroty, and Ott, 1994; Sykes and Irven, 2000). To avoid being cuckolded—being deceived into investing resources in a child which one has not sired—men may have evolved a number of anti-cuckoldry tactics (Gallup and Burch, 2006; Platek and Shackelford, 2006), one of which is mate guarding. Mate guarding refers to the process of safeguarding access to a mate as well as preventing other males from infringing on their significant other (Buss, 1988). This practice has been observed in a variety of species, especially where parental investment by both parents is likely or common. Several evolutionary scientists have theorized that jealousy has evolved as a mate guarding tactic to help ensure that one's partner does not abandon the partnership, either temporarily (e.g., infidelity) or permanently (e.g., divorce; Buss 1988; Buss and Shackelford, 1997; Flinn, 1988). Examples of mate guarding include a broad range of behaviors including making oneself more attractive for one's partner to physically harmful acts such as domestic violence. These tactics may be driven by reproductive (genetic) fitness gains/losses and ultimately aid a male's confidence in paternity. If males are unsuccessful at preventing infidelity by their mate, they risk genetic cuckoldry (Buss, 2002) and might therefore provision offspring which share no genes in common with him. Females who are not successful at mate guarding can also incur risks. For example, unsuccessful mate guarding by a female could lead to loss of resource investment by the male (e.g., diversion of financial and other resources to other sexual partners). Furthermore, social resources in the

form of alliances brought to the relationship by one partner may be lost due to breakup (Buss, 2002).

Sex differences in reaction to a partner's emotional and sexual infidelity are well documented and are hypothesized to be attributable to recurrent sex-specific adaptive problems (Buss, Larsen, Westen, and Semmelroth, 1992; Buss and Shackelford, 1997; Platek and Thomson, 2007; Shackelford et al., 2004). Because of the adaptive problem of paternal uncertainty, men more than women are upset by a partner's sexual infidelity (e.g., having sex with someone else). Because of the adaptive concern with parental investment and resource diversion, women are more upset than men by a partner's emotional infidelity (e.g., falling in love with someone else; Buss et al., 1992; Buss and Shackelford 1997; Shackelford et al. 2000). In Buss et al.'s (1992) landmark study, participants were asked to imagine a romantic partner engaging in a sexual infidelity or emotional infidelity, and to select which of the two would be more upsetting. Although Buss et al.'s (1992) hypotheses and results have been criticized (Buller, 2005; DeSteno, Bartlett, Braverman, and Salovey, 2002; DeSteno and Salovey, 1996; Harris, 2000, 2003a, 2003b), there is a growing consensus that these findings are robust (see Buss and Haselton, 2005; Shackelford, Buss, and Bennett, 2002; Shackelford et. al, 2004; Strout, Laird, Shafer, and Thompson, 2005; Wiederman and Kendall, 1999). There is a growing number of studies, including cross-cultural studies and psychophysiological studies, that have provided convergent support for the evolutionary hypothesis of sex differences in jealousy (see Buunk, Angleitner, Oubaid, and Buss, 1996; Buss and Shackelford 1997; Buss, et al.,1999; de Weerth and Kalma, 1993; Pietrzak, Laird, Stevens and Thompson, 2002; Sagarin, Becker, Guadagno, Nicastle, and Millevoi, 2003; Schützwohl, 2004; Schützwohl and Koch, 2004; Schützwohl, 2006; Shackelford et al. 2000; Wiederman and Allgeier, 1993; Wiederman and Kendall, 1999). However, only a few studies have investigated the possible cognitive mechanisms involved in jealousy-based information processing.

Schützwohl (2004) replicated Buss et al.'s (1992) study, substituting self-report surveys with a computerized task in which reaction times were assessed. Although both men and women reported greater upset to emotional infidelity scenarios, more men than women selected a partner's sexual infidelity as more upsetting. Women selecting emotional infidelity as more upsetting reached their decision faster than women selecting sexual infidelity. In contrast, men selecting sexual infidelity as more upsetting reached their decision faster than men selecting emotional infidelity as more upsetting.

Schützwohl and Koch (2004) investigated the ability to recall cues to sexual and emotional infidelities. Participants were presented one of several stories about a couple spending an evening together. The stories were presented so that infidelity appeared to be neither very likely nor very unlikely. A week later, participants returned to the lab and were unexpectedly asked to recall what they remembered from the story. Men recalled more cues to sexual infidelity and women recalled more of cues to emotional infidelity. In a follow up study, Schützwohl (2005) investigated thresholds of jealous feelings. Participants were presented cues signaling either a mate's sexual or emotional infidelity and were asked to indicate which cue to infidelity elicited "a first sign of feeling jealous" and to indicate which cue would cause them to reply "I won't take it any longer. My jealousy feeling is intolerable" while reaction times were recorded. There were no sex differences found with regard to the number of cues to sexual or emotional infidelity until the first threshold. After the first feeling of jealousy had been identified, men needed fewer cues to sexual infidelity

and women needed fewer cues to emotional infidelity until the second threshold. Men were significantly faster in determining the two thresholds for sexual infidelity and women were faster for cues to emotional infidelity.

Here we used two different tasks to investigate the cognitive-emotional aspects of a putative jealousy mechanism. We used the implicit associations test (IAT; see Greenwald, McGhee, and Schwartz, 1998; Greenwald, Nosek, and Banaji, 2003) to measure implicit associations when participants were asked to categorize words depicting sexual infidelity or emotional infidelity as either positive or negative. Guided by an evolutionary psychological perspective, we predicted a sex-specific reaction time advantage and performance decrement associated with categorizing different types of infidelity-related words as positive or negative. Specifically, we predicted that men would show greater bias (slower reaction time and increased error rate) to words depicting sexual jealousy and that women would show greater bias to words depicting emotional infidelity.

In a second experiment, we modified the Stroop task to measure cognitive effects when primed with infidelity scenarios. The Stroop task has been shown to be a reliable assessment of measuring attentional bias (Williams, Matthews, and MacLeod, 1996) and results of modified Stroop tasks have shown slowed reaction time to emotionally provoking stimuli (Egolf and Schmuckle, 2004; Intili and Tarrier, 1998; Lusher, Chandler, and Ball, 2004). Due to the competing information processing tapping attention, we predicted that men would have slower reaction times and commit more errors when primed with a sexual infidelity scenario and that women would have slower reaction times and commit more errors when primed with an emotional infidelity scenario.

Materials and Methods

Experiment 1: Implicit Association to Infidelity-Related Words

Participants

Sixty-nine undergraduates (34 men; 35 women, *M* age = 20.4) from a Northeastern United States university volunteered for participation. All participants gave written informed consent and received course extra credit for their participation. The study was approved by the local Institutional Review Board.

Apparatus and Procedures

Stimuli were presented to participants on a Gateway desktop with a 15” monitor. Participants were seated 35-40 cm away from the screen. The experiment was run using Presentation® software (Version 0.70, www.neuro-bs.com). In individual sessions, participants were administered a version of the Implicit Association Test (IAT; see Greenwald et al., 1998, and Greenwald et al., 2003). The IAT is a reaction time task used to assess implicit associations between social categories (e.g., race) and semantic concepts (e.g., unpleasantness). Implicit attitudes are thought to be manifest actions or judgments that are under the control of automatically activated evaluations without the performer’s awareness of that causation (Greenwald and Banaji, 1995). The reasoning behind using the IAT in measuring reactions to jealousy information is that it should be easier for one to categorize words typically associated together than it would be for dissimilar words. For example, it would be easier to categorize the word “flower” with the category of *pleasant*,

than say the word "death." We used the IAT to investigate sex differences when engaging in a modified version of the IAT designed to investigate sex-specific adaptive processing of upset to a partner's infidelity. When the stimuli produce cognitive dissonance, longer reaction times and increased number of errors result. We modified the IAT to include presentation of stimulus words differentially associated with sexual infidelity or with emotional infidelity (e.g. abandonment, unfaithful, extramarital, affair, unromantic). For example, if "adultery" is associated with sexual infidelity, than we predicted that men would be slower to categorize the word "adultery" with the category Positive + Sexual Infidelity than they would be to categorize it in the Negative + Sexual Infidelity category.

Twenty words related to infidelity were rated by 87 undergraduates and eight expert judges (professors and graduate students who conduct research on sex differences in jealousy) who did not participate in the study. Words rated as indicating *either* emotional *or* sexual infidelity by >80% of raters were used as stimuli in the IAT. Participants were presented with one word on the screen at a time. In the first block of trials, participants categorized words as either pleasant or unpleasant. In the second block, they categorized words associated with either sexual infidelity or emotional infidelity. A definition of each infidelity type was provided. In the third block of trials, participants were randomly shown the positive, negative, and infidelity-related words and asked to categorize each as either "pleasant" or "unpleasant" *and* "emotional infidelity" or "sexual infidelity" in a counterbalanced design. Reaction time was measured by how long it took them to enter the "correct" answer and answers were considered "errors" when they were not categorized properly. An example of an error would be categorizing the word "cheating" in the pleasant/emotional infidelity category.

Results

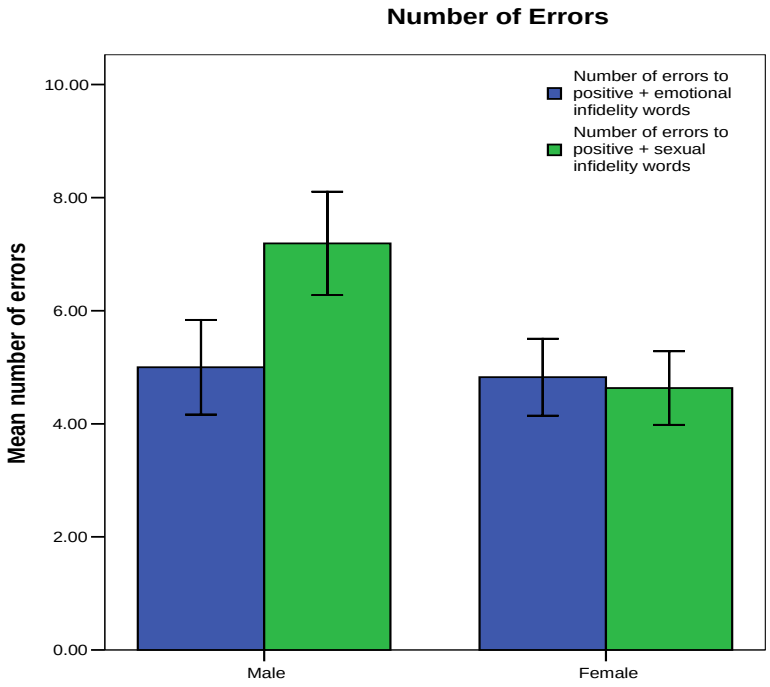
Results for the IAT supported the prediction that men would show greater bias to words depicting sexual jealousy, but did not support the prediction that women would show greater bias to words depicting emotional infidelity. There were no differences in reaction time between men and women, but we did find an effect for number of errors committed. Men made significantly more errors than women when asked to classify sexual infidelity words with the positive/pleasant category (M women = 4.63, men = 7.19; F (1, 66) = 5.19, p <.05; see Figure 1). The other conditions although not statistically significant showed trends in support of our predictions for sex differences. (see Table 1 for full results).

Although the results did not fully support the predictions (i.e., there was no overall reaction time effect or an error effect for emotional infidelity in women), there was evidence that men have greater difficulty than women when asked to categorize a word suggestive of sexual infidelity as being positive. Reference to sexual infidelity may produce greater interference in the cognitive abilities of men than emotional infidelity does for women, a finding that is also evident in Experiment 2.

Table 1: Means (standard deviation) for the Implicit Association Test

	Males	**Females**
Reaction Time -Positive + Emotional Infidelity Words	971.36 (273.06)	952.10 (246.80)
Reaction Time - (Positive + Sexual Infidelity Words	994.86 (291.46)	936.48 (236.61)
Errors – Positive + Emotional Infidelity Words	5.0 (4.89)	4.82 (3.97)
Errors – Positive and Sexual Infidelity Words	7.19 (5.34)	4.63 (3.80)

Figure 1: IAT number of errors



Experiment 2: Stroop Test Primed with Infidelity Scenarios

Participants

Sixty-eight undergraduates (33 men; 35 women *M* age = 21.7) from a Northeastern United States university volunteered for participation. All participants gave written informed consent and received course extra credit for their participation.

Apparatus and Procedures

Stimuli were presented to participants on a Gateway desktop computer with a 15" monitor. Participants were seated 35-40 cm away from the screen. The experiment was run in SuperLab® 2.0 and a Radio Shack desktop computer microphone (model #33-3031) was used to record responses. The cognitive mechanism theoretically associated with this task is inhibition; i.e., participants must inhibit their initial response (e.g., what the word says) and report something different (e.g., color of word). Modified emotional Stroop tests are designed to investigate emotional words instead of the color words in the initial test (e.g., seeing the word "red" in green ink). The modified tests are typically designed to investigate neutral vs. anxiety provoking terms. Research has shown that individuals with psychological disorders show a longer reaction time (RT) during an emotional Stroop test when those words are related to their clinical concerns (e.g., Thomas, Johnstone, and Gonsalvez, 2006). The slower reaction time has been attributed to attentional bias, but this interpretation has been disputed and has been argued to "demonstrate interference from personally relevant stimuli, rather than a clean attentional bias" (see Teachman, Smith-Janik, and Saporito, in press).

In the Stroop task, participants responded to the word on the screen by saying the color of the word into the microphone. The Stroop task began with a practice round consisting of color naming (each item consists of five O's, with each of the series printed in one of five colors [red, orange, green, brown, and blue]). In the second part of the practice round, participants are asked to say the color of the word shown on the screen. Each item was one of five colored words with no words being presented in their own color (e.g., seeing the word red in the color blue). There were three priming conditions: a control condition, an emotional infidelity condition, and a sexual infidelity condition. After priming participants were randomly shown both neutral words and infidelity-related words in each condition. Similar to Intilli and Tarrier (1998), the categorized words included McKenna emotional words (a strong emotional connotation, e.g., crash, fail, fear, death, and grief), McKenna control words (neutral words matched to the previous set on word length; e.g., clock, gate, note, thumb, field), infidelity target words (e.g., suspicious, rival, unfaithful, cheating, false) and control words (words matched for word length and frequency of usage to the infidelity target words; e.g., needlework, flask, helicopter, metaphor, stair).

In the *emotional infidelity condition*, participants were asked to think about and visualize their partner spending time with someone else or having an interest in someone else without having a sexual relationship with that person. In the *sexual infidelity condition*, participants were asked to imagine their partner having a one-night stand or sexual "fling" with someone else but not having any feelings for this individual. In the *control condition*, participants were not asked to imagine any type of scenario. The control condition was

always run first followed by the sexual and emotional infidelity priming conditions using a counterbalanced design. We were not able to record vocal response errors—e.g., saying "blue" when the word was green. SuperLab® 2.0 only has the capability to record reaction time in this type of task.

Table 2: Means (standard deviation) for the control and priming conditions in the Stroop task:

CONDITION	**MALES**	**FEMALES**
Control Condition	757.48 (165.66)	834.75 (185.63)
Emotional Infidelity	775.02 (166.61)	853.75 (201.11)
Sexual Infidelity	865.73 (215.83)	832.32 (174.04)

Results

Reaction times less than 300 ms and greater than 3500 ms were excluded from analysis (similar to Yovel and Mineka, 2004). These outlier reaction times would typically occur because the microphone may not have picked up their initial response.

The results of the Stroop task were consistent with our predictions. We found a main effect for the priming conditions, F (2, 132) = 4.29, $p < .05$. A significant interaction was also found between priming and sex, F (2,132) = 6.14, $p < .01$, indicating that men's reaction time was longer when primed with sexual infidelity (see Table 2). This suggests that the priming conditions did impact the reaction time of participants and that a significant sex difference exists. There were four categorizations used within each of the priming conditions. Following, we present key results for each of the four categorizations across conditions.

In the *Infidelity Control* category, there was no overall main effect, F (2, 132) = 2.31, $p > .05$, and no interaction between the *Infidelity* control words and sex, F (2,132) = 0.99, $p > .05$. In the *Infidelity Target* category, there was no main effect, F (2, 132) = 0.38, $p > .05$, but there was a significant interaction between the infidelity target words and sex, F (2, 132) = 6.35, $p < .01$, indicating that men's reaction time increased when primed with sexual infidelity (See Figures 2a and 2b). In the *McKenna Control* category, there was an overall main effect, F (2, 132) = 3.22, $p < .05$ and a significant interaction between McKenna control words and sex, F (2, 132) = 4.68, $p < .05$. In the *McKenna Target* category, there was a significant main effect, F (2, 132) = 4.77, $p = .01$, and a significant interaction between the McKenna target category and sex, F (2, 132) = 5.83, $p < .01$ (see Figures 3a and 3b).

Figure 2: (a) Mean reaction time for jealousy target words across conditions **(b)** Mean reaction time for jealousy control words across conditions

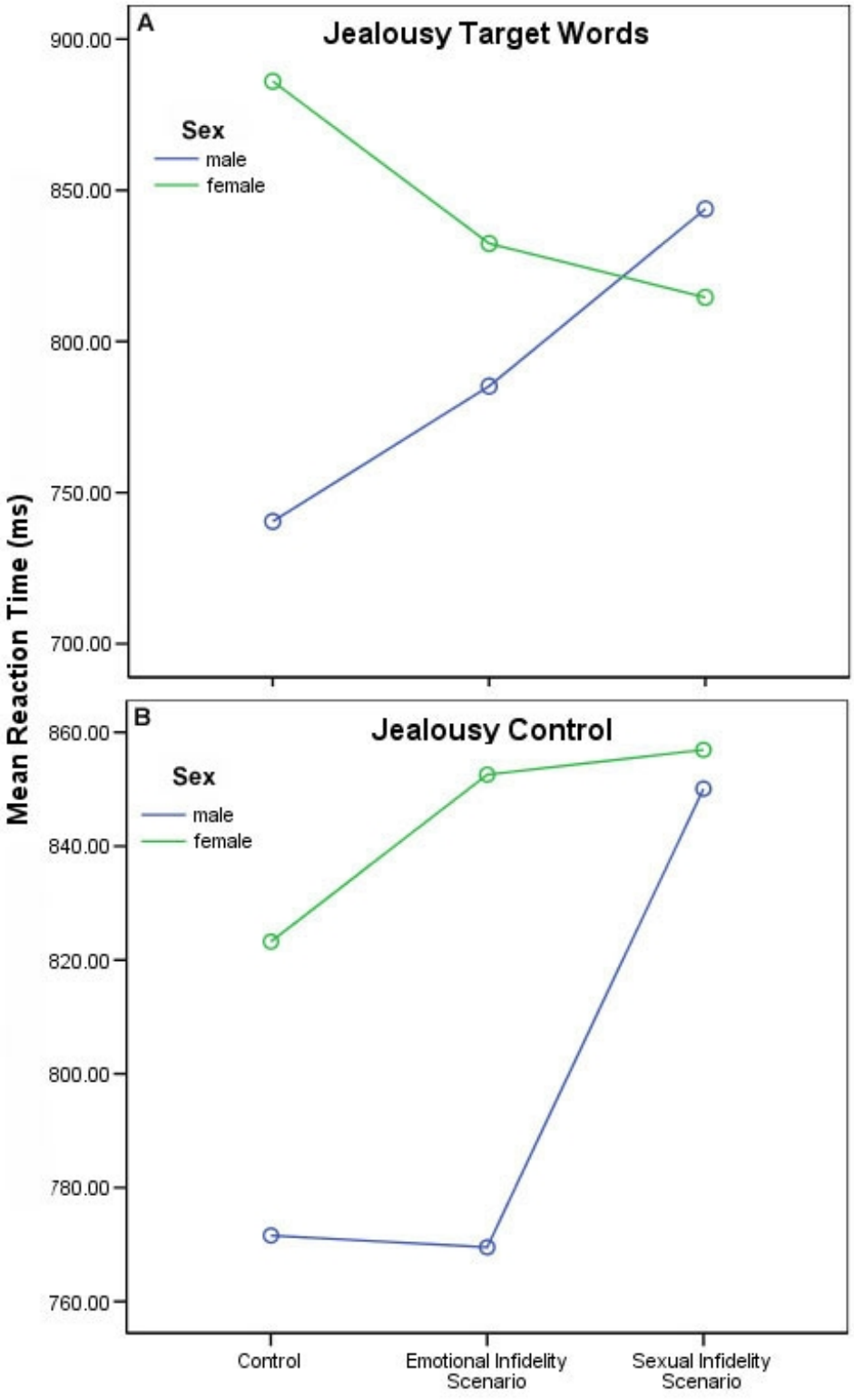
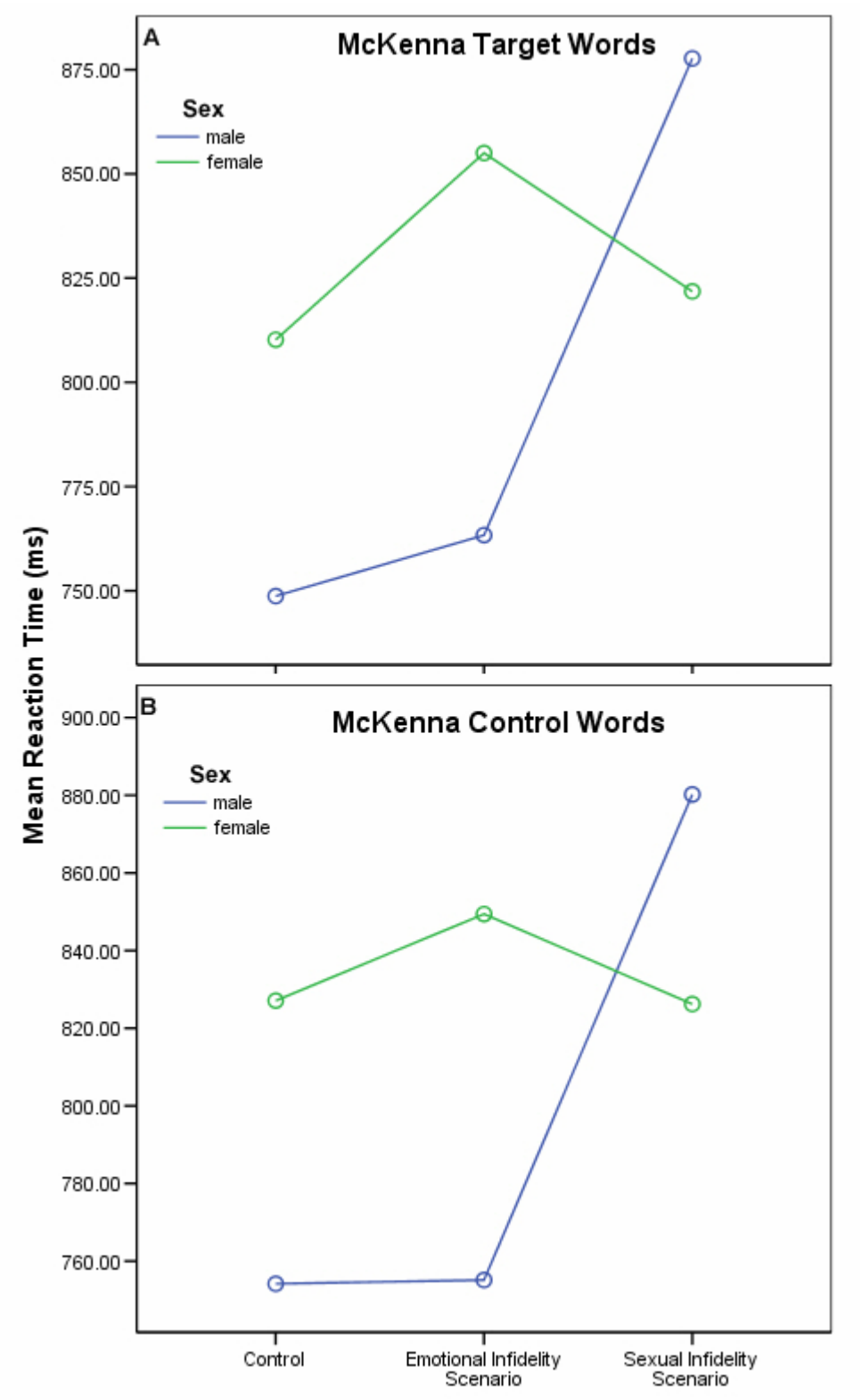


Figure 3: (a) Mean reaction time for McKenna target words across conditions **(b)** Mean reaction time for McKenna control words across conditions



A within-participants ANOVA generated a main effect for the Infidelity and McKenna control categories, F (2, 132) = 3.91 $p < .05$, and an interaction between the control conditions and sex, F (2, 132) = 3.45, $p < .05$. This trend was slightly different when this test was conducted on the target words: a main effect was not observed for the Infidelity and McKenna target words, F (2, 132) = 2.47, $p > .05$, but there was a significant interaction between the target words and sex, F (2, 132) = 7.35, $p < .01$ (see Table 3 for Mean scores by category).

Table 3: Mean Reaction Time (standard deviation) as a function of conditions used in the Stroop task

Category	**Condition**	**Male**	**Female**
Jealousy Control Words	Control	771.59 (171.92)	823.23 (163.83)
	Emotional Infidelity	769.53 (217.71)	852.58 (254.34)
	Sexual Infidelity	850.10 (207.38)	856.93 (184.61)
Jealousy Target Words	Control	740.48 (166.11)	866.04 (267.31)
	Emotional Infidelity	785.19 (207.88)	832.40 (212.99)
	Sexual Infidelity	843.84 (216.58)	814.57 (173.27)
McKenna Control Words	Control	754.17 (239.96)	827.09 (231.80)
	Emotional Infidelity	755.13 (169.29)	849.40 (179.21)
	Sexual Infidelity	880.21 (215.93)	826.20 (186.60)
McKenna Target Words	Control	748.71 (181.63)	810.22 (190.39)
	Emotional Infidelity	763.34 (159.35)	855.00 (241.24)
	Sexual Infidelity	877.69 (276.37)	821.82 (206.57)

Discussion

The current results, for men, are consistent with the evolutionary hypothesis of sex differences in reaction to a partner's infidelity. These results support the hypothesis for a male bias to processing information about sexual infidelity implicitly, which further supports the hypothesis of an evolved cognitive adaptation for the detection and correction of infidelity (Shackelford, 2003). When men are performing implicit cognitive tasks while asked to think about sexual infidelity, the interference caused by these thoughts slows performance and produces more errors. The male mind may be more likely to attend to sexual infidelity because this would have been an adaptive mate guarding strategy. There may be a tradeoff between processing cognitive tasks and mate guarding, and for men's fitness; i.e., solving the adaptive problem of maintaining their partner's fidelity might override other types of cognitive processing, and consequently hijack attentional resources being utilized to process other types of information in their environment.

We did not find support for the prediction that women would have a slower reaction time and commit more errors when primed with an emotional infidelity scenario. These data are in contrast to recent evidence indicating that women are more attuned to information about emotional infidelity (Buss et al., 1992; Buss and Shackelford, 1997; Buss et al 1999; Pietrzak et al., 2002; Sagarin et al., 2003; Schützwohl 2004; Schützwohl and Koch, 2004; Shackelford et al., 2000). For women, emotional infidelity might not impact cognitive systems involved in attention to the same degree that sexual infidelity does for men. This finding is consistent with the nature of sexual infidelity and emotional infidelity: the detection of sexual infidelity can occur in one instance; that is the discovery of a partner's sexual infidelity can happen quickly and once it is known or certain it is clear. However, emotional infidelity often takes time to develop, thus the discovery of emotional infidelity may trigger cognitive processes involved with episodic memory (e.g., remembering episodes when a partner has expressed emotional attachment to another) rather than attention.

This research has several limitations. The samples were limited to university students. Replication of this study using a sample with more experience in romantic relationships would help to establish the generalizability of the results. Individuals who are older than those in the current young adult college samples may be more likely to have had serious long-term relationships and more relationships in which they experienced a partner's infidelity. One of the limitations experienced with the Stroop task was that the software we used was unable to record errors (e.g., saying "blue" when the word was green). Although the reaction time information did provide some of the information we sought, the number and type of errors across conditions might have provided more evidence and better comparison to the Implicit Association Test. Future research should continue to investigate what types of cognitive processing (e.g., attention, memory) is impacted by strategies selected to detect a partner's infidelity.

Although both sexes are upset by a partner's infidelities, the current research suggests that men's cognitive skills may be especially impacted by processing information related to a partner's sexual infidelity. This research adds to a growing literature on the emotion of jealousy and on the sex differences in experienced jealousy. A better understanding on the cognitive effects of experiencing jealousy might result in improving the care provided to individuals who experience extreme levels of jealousy and may lead to better identifying potentially dangerous behaviors which result from extreme jealous behavior.

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