

## Emotion and Motivation II: Sex Differences in Picture Processing

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Adhering to the view that emotional reactivity is organized in part by underlying motivational states—defensive and appetitive—we investigated sex differences in motivational activation. Men's and women's affective reactions were measured while participants viewed pictures with varied emotional and neutral content. As expected, highly arousing contents of threat, mutilation, and erotica prompted the largest affective reactions in both men and women. Nonetheless, women showed a broad disposition to respond with greater defensive reactivity to aversive pictures, regardless of specific content, whereas increased appetitive activation was apparent for men only when viewing erotica. Biological and sociocultural factors in shaping sex differences in emotional reactivity are considered as possible mediators of sex differences in emotional response.

In "Emotion and Motivation I" (Bradley, Codispoti, Cuthbert, & Lang, 2001) we proposed that emotion is fundamentally organized by two systems—one appetitive and one defensive—that have evolved to mediate transactions in the environment that promote or threaten the survival of individuals and species. In "Emotion and Motivation II," we explore whether there are sex differences in defensive or appetitive activation. In Western culture at least, a persisting stereotype is that women are more emotional than men (Fischer & Manstead, 2000) and, in particular, more reactive to unpleasant events, especially those that are threatening or traumatic (Allen & Haccoun, 1976; Kring & Gordon, 1998). Epidemiological studies indicate that women are at a higher risk for affec-

tive disorders, such as anxiety and depression (Nolen-Hoeksema, 1987; Sachs-Ericsson & Ciarlo, 2000), suggesting a higher incidence of negative affect, held to involve heightened reactions to aversive stimulation (Watson, Clark, & Mineka, 1994). Attributing specifically aversive hyperreactivity to women has been questioned, however (Alexander & Wood, 2000), based on evidence that women also report experiencing more happiness and joy (e.g., Brody, 1996). In the current study, we investigated men's and women's reactions to a variety of different pleasant and unpleasant picture contents that differentially activate defensive or appetitive motivation.

From the motivational perspective advocated here, cues that activate appetitive and defensive systems should be potent for both men and women, who share survival risks. Nonetheless, differential activation of these motivational systems could arise. For example, differences between the sexes in size or strength may mediate differential responses to threat, and sociocultural learning could selectively reinforce differences in the expression of emotionality in men and women. Most theories regarding sex differences in emotionality acknowledge the possibility of both biological and sociological contributors to differential emotional experience and expression.

Consistent with a biological view, women consistently report more fear in threatening situations, judging that they would be unable to physically protect themselves if attacked (Gordon & Riger, 1991). However, the fact that men and women differ particularly in facial expressivity and evaluative judgments

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(LaFrance & Banaji, 1992)—two measures that are particularly vulnerable to social learning and “voluntary” control—suggests that women’s enhanced response may be due to cultural shaping and reinforcement. Numerous studies have found that women are more facially expressive than men (Kring & Gordon, 1998; O’Gorman, 1983; Schwartz, Brown & Ahern, 1980), including when viewing pictures (Lang, Greenwald, Bradley, & Hamm, 1993), and women also rate emotional pictures more extreme in hedonic valence than do men. Conversely, research on sexuality has consistently found that, in the context of erotic stimuli, men routinely report more emotional arousal than do women (see Murnen & Stockton, 1997, for a recent overview). Thus, rather than women being more emotionally expressive in all affective contexts, it is possible that different cues arouse emotion in men and women.

### The Research Problem

In the current study, men’s and women’s responses to a variety of different picture stimuli were explored in multiple response systems, including skin conductance, heart rate, reflex modulation, facial electromyographic (EMG) activity, and evaluative judgments. This multisystem measurement allowed us to determine whether sex differences are more marked in response systems that are less readily influenced by social and cultural learning—for example, autonomic responses (i.e., cardiac and electrodermal) and reflex modulation—or more readily influenced in systems under voluntary control (e.g., facial expression and evaluative judgments). The range of affective picture contents studied here varied from stimuli presumed to strongly activate defensive and appetitive systems—including threat, mutilation, and erotica—to those that are less engaging and are typically rated lower in arousal, including, for unpleasant contents, pictures of pollution, loss, illness, contamination, and accidents and, for pleasant contents, pictures of nature, families, food, adventure, and sports. This design allowed us to determine whether men and women differed generally in response to all contexts of a specific valence (e.g., unpleasant) or whether specific contexts (e.g., erotic, threat) may vary in affective meaning and prompt differential responding on the basis of the participant’s sex.

### Theoretical Considerations and Hypotheses

Past research has not uncovered stable differences between men and women in physiological responses

to emotional cues, which is at least partly attributed to a lack of systematic research in this area (Manstead, 1992). The data presented in “Emotion and Motivation I” (2001) provided support for the idea that different physiological systems react at different levels of defensive and appetitive activation. Thus, for instance, augmented skin conductance responses, a signal of heightened sympathetic nervous system involvement, depend on a relatively high threshold of defensive activation. If unpleasant pictures prompt greater defensive activation for women, we expect increased electrodermal responses when women view these pictures, compared with men. If women are specifically more reactive to contexts that involve threat and elicit fear, we expect that differential reactivity should be confined to pictures of attack and mutilation. Similarly, for appetitive stimuli, augmented skin conductance was obtained only for erotic pictures. If men are specifically more reactive to these types of affective cues, we expect greater reactivity for men, compared with women.

The prototypical heart rate response when viewing unpleasant pictures consists of a sustained deceleration, interpreted here as indicative of orienting and attention. If aversive stimuli prompt greater defensive activation in women, we expected greater cardiac deceleration when women view these pictures, compared with men, and particularly in contexts involving threat, if women’s hyperreactivity is confined to fearful cues. Similarly, erotic stimuli prompt an enhanced initial deceleration, compared with other pleasant picture contents, again attributed to increased orienting and attention, and we expected greater deceleratory activity when men view these pictures if erotic stimuli are more activating for male participants.

The startle reflex is inhibited for the least arousing, unpleasant pictures but then rises linearly with increases in the intensity of defensive activation (Bradley et al., 2001; Cuthbert et al., 1996). The greatest potentiation is found for pictures of threat. For pleasant pictures, however, startle magnitude is reduced as arousal increases, with the greatest inhibition for pictures involving erotica. Reflex modulation is a good index of underlying differences in motivational activation for men and women, not only because this involuntary reflex is not susceptible to voluntary control, but because it appears to vary systematically with the degree of appetitive or defensive activation. If erotic stimuli prompt more appetitive activation for men, we expected evidence of greater reflex inhibition when viewing these materials, compared with women; conversely, if women are more reactive in

general to unpleasant stimuli, or specifically more reactive to those involving threat, we expected evidence of greater potentiation.

In both evaluative judgments and facial EMG reactivity, we expected to replicate previous findings that women are more facially expressive than men and, for contexts other than erotica, to report more intense affective experience. Inclusion of multiple affective contexts allowed us to determine whether the pattern of emotional modulation for different measures is similar for both men and women, with differences mainly in degree of responding, or whether men and women react differently to specific contexts involving, for instance, fear and erotica. Evaluative judgments of pleasure and arousal can also be plotted in a two-dimensional affective space, which we have argued reflects the underlying organization of appetitive and defensive motivational systems, and these were assessed separately for male and female participants. In Experiment 2, we asked men and women to label their affective experiences when viewing different picture contexts, with the goal of determining whether men and women differ in the emotional labels they apply to their emotional experience and how this illuminates differential emotional reactivity.

## Experiment 1

### Method

*Participants.* Participants were 50 women and 45 men from a University of Florida introductory psychology class who received course credit. Because of computer or experimenter error, data for some participants and measures were unavailable. Final *N*s were as follows: corrugator EMG,  $n = 95$ ; zygomatic EMG,  $n = 95$ ; heart rate,  $n = 94$ ; skin conductance responses,  $n = 95$ ; startle blink reflexes,  $n = 85$  (44 women); orbicularis oculi EMG,  $n = 92$ ; and evaluative judgments,  $n = 94$ .

*Materials and design.* The materials and design were the same as that described in Part I of Bradley et al. (2001). Briefly, 72 pictures were selected from the *International Affective Picture System*<sup>1</sup> (Center for the Study of Emotion and Attention [CSEA-NIH], 1999; Lang, Bradley, & Cuthbert, 1999) that included four exemplars in each of 18 different picture contents, including 8 pleasant (nature, families, food, sports, adventure, attractive men, attractive women, erotic couples), 2 neutral (household objects, mushrooms) and 8 unpleasant (pollution, illness, loss, accidents, contamination, attacking animals, attacking humans,

mutilated bodies). Each picture was presented for 6 s on a 19-in. (48.3 cm) monitor.

Stimulus control and physiological data acquisition were accomplished by using an IBM-compatible computer running VPM data acquisition and reduction software (Cook, 1997). Physiological signals (heart rate, skin conductance, corrugator EMG, zygomatic EMG, orbicularis oculi EMG) were sampled at 20 Hz for 3 s before picture onset, for 6 s during picture presentation, and for 2 s after picture offset. Electrode placement and data acquisition were as described in Bradley et al. (2001). An acoustic startle stimulus, consisting of a 50-ms presentation, 95 dB (A) burst of white noise, was presented on half of the trials in each picture category (i.e., 36 of the 72 pictures), between 3 and 5 s after picture onset. Pleasure, arousal, and dominance ratings were obtained using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994; Lang, 1980).

*Procedure.* The procedure was as described in Bradley et al. (2001). The participant was instructed to view each picture as it appeared on the screen, and to make ratings of pleasure, arousal, and dominance after picture presentation by using SAM. The participant was instructed that brief noises heard over the headphones could simply be ignored.

*Data reduction and analysis.* Reactions in corrugator, zygomatic, and orbicularis oculi EMG, skin conductance, and heart rate were determined by subtracting activity in the 1 s before picture presentation from that occurring at each half-second after picture onset. For facial EMG activity, the average changes over the 6-s picture period were used to summarize reactions to picture presentation. For skin conductance, the maximum change occurring between 1 and 4 s after picture onset was scored, and a log transformation ( $\log [\text{SCR} + 1]$ ) was performed to normalize the data. Heart rate waveform scores were computed by determining, for each participant and each trial, the maximum deceleration from baseline in the first 3 s of picture viewing and the peak acceleration from baseline in the last 3 s of picture viewing (c.f. Hodes, Cook, & Lang, 1985). The blink data were reduced

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<sup>1</sup> The International Affective Picture System (IAPS; CSEA, 1999) is available on CD-ROM and as photographic slides. The stimulus sets and technical manual (Lang, Bradley, & Cuthbert, 1999) can be obtained on request from the authors at the Center for the Study of Emotion and Attention, P.O. Box 100165 HSC, University of Florida, 32610-0165.

off-line using a program that scored each trial for magnitude in analog-to-digital units and onset latency in milliseconds, using an algorithm devised by Globisch, Hamm, Schneider, & Vaitl (1993).

### Results

**Affective space.** Figure 1 presents each of the 72 pictures used in this study (solid circles) in the two-dimensional space formed by plotting each picture by its mean pleasantness and arousal rating separately for the men (left panel) and women (right panel). The quadratic correlation between ratings of pleasure and arousal was significant for both men ( $r = .59$ ) and women ( $r = .49$ ), indicating that as pictures were rated as increasingly more pleasant or more unpleasant, arousal ratings tended to increase as well. The vectors describing appetitive and defensive motivation were determined by computing the correlation between pleasure and arousal ratings separately for pleasant pictures (appetitive motivation) and unpleasant pictures (defensive motivation).

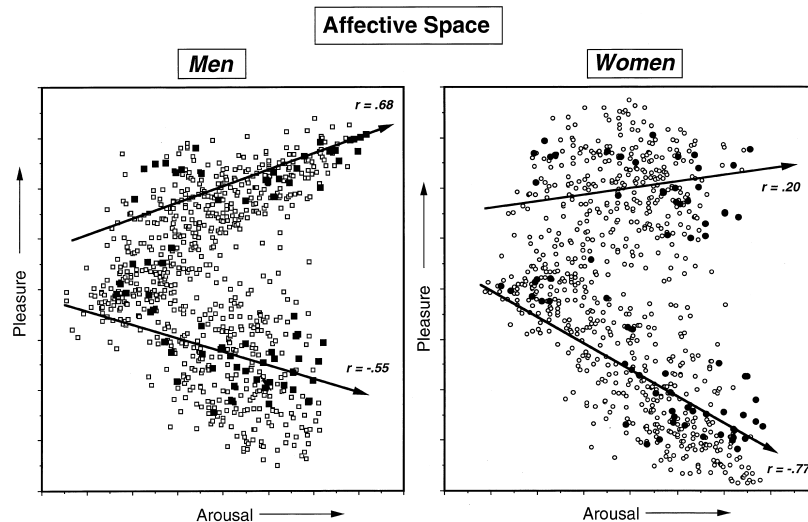
For unpleasant pictures (mean pleasure rating  $<10$ ), women showed a significantly larger ( $r = -.77$ ;  $z = 2.34$ ,  $p < .05$ ) negative correlation between ratings of pleasure and arousal, compared with men ( $r = -.55$ ), and for women, pictures projected further into the

unpleasant, arousing quadrant than for men, as illustrated in Figure 1. Thus, women showed a stronger coupling between ratings of unpleasantness and arousal than did men and rated the most unpleasant pictures as more arousing than did men.

For pleasant pictures (mean pleasure rating  $>10$ ), however, a different pattern emerged. Now, men showed a significantly stronger positive correlation ( $r = .68$ ) between ratings of pleasure and arousal, compared with women ( $r = .20$ ;  $z = 3.66$ ,  $p < .01$ ), and for men, pictures tended to project further into the pleasant, arousing quadrant than for women, as illustrated in Figure 1. Thus, men showed a stronger coupling between pleasure and arousal for pleasant pictures than did women, and also tended to find the most pleasant pictures more arousing than did women.

**Hedonic valence.** Table 1 lists the means for each measure as a function of picture valence separately for men and women. Significant effects of picture valence were obtained for men and women in all measures, except for zygomatic EMG activity, in which men did not show differential activity, and orbicularis oculi EMG activity, in which neither men nor women showed significant differences.

Men and women did not react identically to pleasant, neutral, and unpleasant pictures, however, as evi-



*Figure 1.* Each of the 72 pictures presented in this experiment (solid symbols) is plotted in the affective space formed by its mean pleasure and arousal rating scale, separately for men (left panel) and women (right panel) in this study. Open symbols depict International Affective Picture System (IAPS) pictures that were not presented in this experiment. Compared with women, men showed a stronger coupling between increased arousal and pleasantness (i.e.,  $r = .68$  vs.  $r = .20$ ), whereas compared with men, women showed a stronger coupling between increased arousal and ratings of unpleasantness (i.e.,  $r = -.77$  vs.  $r = -.55$ ).

Table 1

Mean Ratings of Pleasure, Arousal, and Dominance and Physiological Reactions for Women and Men When Viewing Pleasant, Neutral, and Unpleasant Pictures

Dependent variable	Pleasant	Neutral	Unpleasant	Main effect
Women				
Pleasure ratings (1–20)	15.2	10.0*	3.9*	$F(2, 47) = 143.0^{abc}$
Arousal ratings (1–20)	11.5	4.7	13.8*	$F(2, 47) = 131.0^{abc}$
Dominance ratings (1–20)	12.8*	13.3	6.5	$F(2, 47) = 60.5^{bc}$
Corrugator EMG $\Delta$ ( $\mu$ V)	0.54	0.97*	1.45*	$F(2, 48) = 22.5^{abc}$
Orbicularis oculi EMG $\Delta$ ( $\mu$ V)	0.81*	0.50	0.63*	$F(2, 48) = 2.5^{ns}$
Zygomatic EMG $\Delta$ ( $\mu$ V)	0.49*	0.14	0.11	$F(2, 48) = 9.0^{ab}$
Skin conductance $\Delta$ (log $\mu$ S + 1)	0.02	0.02	0.03	$F(2, 48) = 4.6^{bc}$
Initial HR deceleration (bpm)	-4.34	-3.65*	-4.92	$F(2, 48) = 9.9^{bc}$
Peak HR acceleration (bpm)	3.05	3.53	1.83	$F(2, 48) = 11.5^{bc}$
Startle reflex magnitude (T score)	49.2	49.1	51.4	$F(2, 47) = 10.5^{bc}$
Men				
Pleasure ratings (1–20)	16.1	10.7*	6.1*	$F(2, 43) = 150.0^{abc}$
Arousal ratings (1–20)	12.5	5.4	12.1*	$F(2, 43) = 90.0^{bc}$
Dominance ratings (1–20)	14.2*	13.4	7.5	$F(2, 43) = 72.0^{bc}$
Corrugator EMG $\Delta$ ( $\mu$ V)	0.28	0.39*	0.49*	$F(2, 43) = 9.5^b$
Orbicularis oculi EMG $\Delta$ ( $\mu$ V)	0.26*	0.38	0.34*	$F(2, 43) = 1.1^{ns}$
Zygomatic EMG $\Delta$ ( $\mu$ V)	0.22*	0.24	0.15	$F(2, 43) = 0.75^{ns}$
Skin conductance $\Delta$ (log $\mu$ S + 1)	0.03	0.02	0.03	$F(2, 43) = 5.4^{ac}$
Initial HR deceleration (bpm)	-4.27	-3.37*	-4.87	$F(2, 42) = 19.9^{ac}$
Peak HR acceleration (bpm)	2.43	3.74	1.40	$F(2, 43) = 13.1^{abc}$
Startle reflex magnitude (T score)	49.7	52.4	50.4	$F(2, 42) = 5.8^a$

Note. Initial heart rate is scored as the maximum deceleration in the first 3 s of picture viewing. Peak heart rate is scored as the maximum acceleration in the last 3 s of picture viewing. EMG = electromyographic; bpm = beats per minute; HR = heart rate.

<sup>a</sup> Comparison of pleasant versus neutral conditions is significant at  $p < .05$ .

<sup>b</sup> Comparison of pleasant versus unpleasant conditions is significant at  $p < .05$ .

<sup>c</sup> Comparison of unpleasant versus neutral conditions is significant at  $p < .05$ .

\*  $p < .05$ .

denced by significant interactions of sex and picture valence in pleasure ratings,  $F(2, 91) = 3.45, p = .036$ ; arousal ratings,  $F(2, 91) = 9.36, p < .001$ ; skin conductance response,  $F(2, 92) = 4.59, p = .013$ ; corrugator EMG activity,  $F(2, 92) = 10.39, p < .001$ ; and zygomatic EMG activity,  $F(2, 92) = 4.28, p = .017$ .

First, these interactions were pursued by simple main effects tests comparing the responses of men and women to pleasant, neutral, or unpleasant pictures. Compared with men, women were more reactive to unpleasant materials, rating these pictures as more arousing,  $F(1, 92) = 7.53, p = .007$ , and more unpleasant,  $F(1, 92) = 16.72, p < .001$ ; and also reacting with larger changes in corrugator EMG activity,  $F(1, 93) = 11.67, p = .001$ . Compared with men, women also rated neutral pictures as slightly less pleasant,  $F(1, 92) = 4.71, p = .03$ , and reacted with slightly more corrugator EMG activity,  $F(1, 93) = 7.10, p = .009$ . Men tended to be more reactive than women when viewing pleasant pictures, rating these pictures slightly more pleasant,  $F(1, 92) = 3.41, p =$

.07, and more arousing,  $F(1, 92) = 3.38, p = .069$ ; and reacting with more skin conductance activity,  $F(1, 93) = 3.29, p = .07$ , though these effects were only marginal when averaged across all categories of pleasant pictures.

Second, the pattern of responding to pleasant, neutral, and unpleasant pictures was assessed separately for men and women (see Table 1, right column). As expected, both men and women rated pleasant, neutral, and unpleasant pictures as significantly different in valence. Whereas women rated unpleasant pictures as more arousing than pleasant pictures,  $F(1, 48) = 28.39, p < .001$ , men rated these pictures as equivalently arousing,  $F < 1$ . Consistent with the idea that women found unpleasant pictures more arousing, women responded with greater skin conductance change when viewing unpleasant, compared with pleasant,  $F(1, 49) = 7.49, p = .009$ , or neutral pictures,  $F(1, 49) = 5.73, p = .02$ ; whereas men responded with equivalent skin conductance changes when viewing pleasant or unpleasant pictures, which

were significantly larger than when viewing neutral pictures (pleasant vs. neutral,  $F(1, 44) = 11.00, p = .002$ ; unpleasant vs. neutral,  $F(1, 44) = 4.46, p = .04$ ). Although men reacted with greater corrugator EMG activity when viewing unpleasant, compared with pleasant, pictures,  $F(1, 44) = 4.53, p = .01$ , women showed more differentiation, with corrugator EMG activity increasing when viewing unpleasant, compared with neutral, pictures,  $F(1, 49) = 8.89, p = .004$ ; and decreasing when viewing pleasant, compared with neutral, pictures,  $F(1, 49) = 12.73, p = .001$ . For zygomatic EMG activity, whereas men did not differentially react to picture valence, greater zygomatic EMG activity was elicited when women viewed pleasant, compared with neutral,  $F(1, 49) = 6.45, p = 0.14$ , or unpleasant pictures,  $F(1, 49) = 18.02, p < .001$ .

For the startle reflex, men and women varied in the pattern of startle modulation,  $F(2, 82) = 8.57, p < .001$ . Significant effects of picture valence on blink magnitude were obtained for both men,  $F(2, 39) = 5.54, p = .008$ , and women,  $F(2, 42) = 8.87, p = .001$ , but the pattern varied. Consistent with other evidence of their greater reactivity to unpleasant pictures, women showed larger reflexes when viewing unpleasant, compared with neutral,  $F(1, 43) = 8.72, p = .005$ , or pleasant pictures,  $F(1, 43) = 17.04, p < .001$ , whereas men showed smaller reflexes when viewing pleasant, compared with neutral, pictures,  $F(1, 40) = 11.15, p = .002$ . When averaged across all stimulus contents, men tended to show smaller reflexes when viewing unpleasant, compared with neutral, pictures,  $F(1, 40) = 5.82, p = .02$ .

*Defensive activation.* To assess differential defensive reactivity in men and women as it varies with specific picture content, we conducted analyses using sex and picture content (eight contents: human attack, animal attack, mutilation, accidents, contamination, illness, loss, and pollution) in a mixed analysis of variance (ANOVA). Main effects of sex, but no interactions involving sex and stimulus content, were obtained in both pleasure,  $F(1, 92) = 16.68, p < .001$ , and arousal ratings,  $F(1, 92) = 7.53, p = .007$ , indicating that women rated all types of unpleasant pictures as more unpleasant and more arousing than did men, regardless of specific content (see Figure 2).

Consistent with reports of greater unpleasantness, a main effect of sex was also obtained in initial cardiac deceleration,  $F(1, 92) = 3.97, p = .049$ , which indicated that women responded with more cardiac deceleration when viewing unpleasant pictures, compared with men, regardless of specific content (see

Table 2). However, although women reported greater arousal when viewing unpleasant pictures, the magnitude of skin conductance change across different unpleasant picture contents was similar for men and women, with the largest changes elicited when viewing pictures depicting attack and mutilation for both men and women (see Figure 3).

To some extent modulation of the startle reflex was also similar for men and women, as the lack of a significant Sex  $\times$  Stimulus Content interaction and Figure 4 (bottom panel) illustrate. When unpleasant pictures were ordered by arousal ratings, significant linear trends were found for both men,  $F(1, 40) = 5.57, p = .02$ , and women,  $F(1, 43) = 19.77, p < .001$ , indicating that larger reflexes were elicited as unpleasant picture contents were rated more arousing. For both men and women, the largest blinks were elicited when viewing pictures depicting threat (i.e., animal or human attack). In addition, for both men and women, blinks elicited when viewing the most arousing unpleasant contents (i.e., animal and human attack) were significantly larger than when viewing the most arousing pleasant contents (i.e., erotic couples and opposite-sex erotica), consistent with past research indicating that the largest differences in reflex modulation occur for the most highly arousing content,  $F(1, 43) = 36.32, p < .001$ , for women;  $F(1, 40) = 18.84, p < .001$ , for men.

Nevertheless, a main effect of sex in analysis of the reflex data,  $F(1, 83) = 7.78, p = .007$ , suggested differences between men and women in the relative size of reflexes elicited when viewing unpleasant pictures, relative to when viewing other pictures. When compared with blinks elicited during neutral pictures ( $M = 51.7$  and  $54.0$  for household objects and mushrooms, respectively), for instance, men showed significantly smaller blinks when viewing many of the unpleasant contents, including pollution, loss, illness, disgust, accidents, and mutilations. For women, however, blinks elicited when viewing contamination, mutilation, animal attack, and human attack were significantly larger than those elicited when viewing neutral pictures ( $M = 49.4$  and  $49.1$  for household objects and mushrooms, respectively). Thus, compared with neutral pictures, men tended to show blink inhibition when viewing moderately arousing unpleasant pictures, whereas women showed potentiation when viewing highly arousing unpleasant pictures.

As expected, a main effect of sex was found in both corrugator EMG activity,  $F(1, 93) = 11.62, p = .001$ , and orbicularis oculi EMG activity, with women

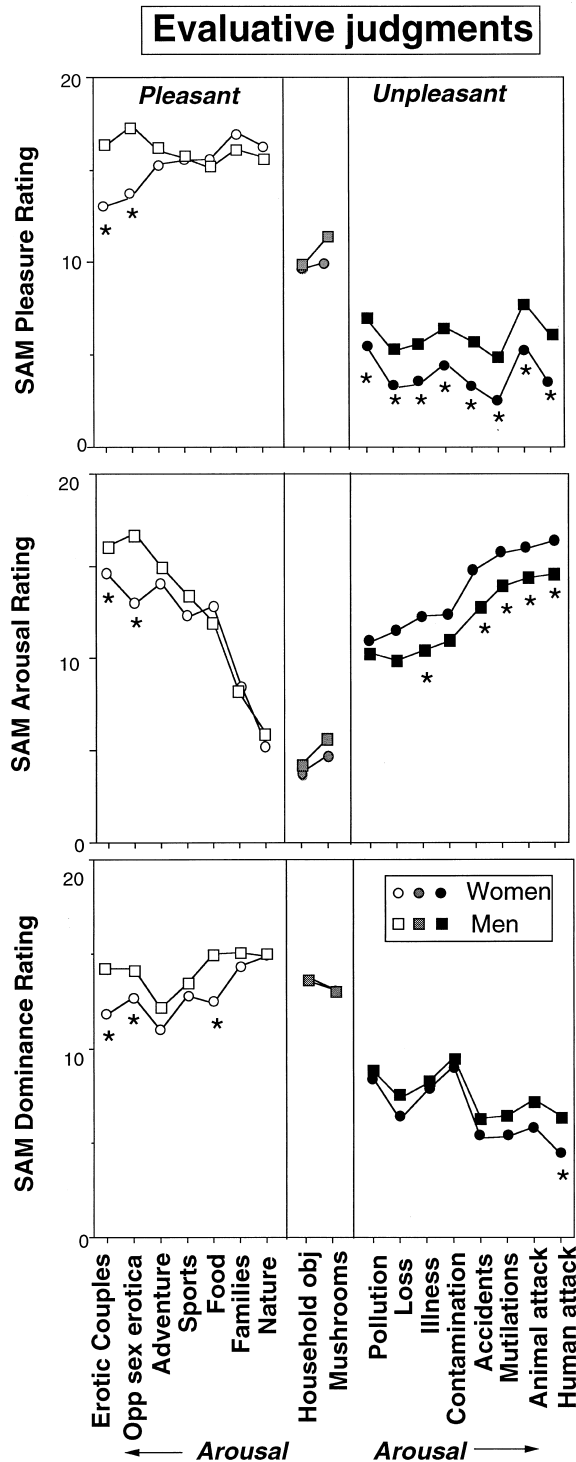


Figure 2. Evaluative judgments of pleasure (top), arousal (middle), and dominance (bottom) for specific pleasant (open symbols), neutral (shaded symbols), and unpleasant (solid symbols) picture contents for men (square symbols) and women (circular symbols). Asterisks indicate significant difference in ratings for that content when women were compared with men ( $p < .05$ ). SAM = self-assessment manikin; Opp = opposite; obj = object.

showing more activity over both muscle sites than men (see Figure 5), and in none of these analyses was the interaction of sex and specific content<sup>2</sup> significant. Thus, although women responded with larger changes in facial EMG activity (see Figure 5) when viewing unpleasant pictures, the pattern of differential activity as a function of specific content was similar for men and women.

**Appetitive activation.** To assess differences in appetitive reactions for men and women, we conducted analyses using sex and picture content (seven types: erotic couples, opposite-sex erotica, adventure, sports, food, families, nature) in a mixed ANOVA. Men and women reacted differently to specific pleasant contents, as evidenced by significant interactions between sex and stimulus content in analyses of pleasure ratings,  $F(6, 87) = 8.75, p < .001$ ; and arousal ratings,  $F(6, 87) = 5.69, p < .001$ . A number of these effects involved erotic materials. Planned comparisons indicated that men rated erotic materials (either couples or opposite-sex erotica) as more pleasant,  $F(1, 92) = 28.72, p < .001$ , for erotic couples,  $F(1, 92) = 44.42, p < .001$ , for opposite-sex erotica, and more arousing,  $F(1, 92) = 6.58, p = .01$ , for erotic couples,  $F(1, 92) = 32.99, p < .001$ , for opposite-sex erotica, than did women (see Figure 2).

For skin conductance, a marginal main effect for sex,  $F(1, 93) = 3.23, p = .07$ , suggested that men were more reactive to pleasant stimuli than women, and consistent with men's ratings, planned comparisons indicated that larger skin conductance changes were obtained when men viewed opposite-sex erotica,  $F(1, 93) = 6.09, p = .015$ , compared with women, as well as a trend in the same direction when men viewed erotic couples,  $F(1, 93) = 3.44, p = .07$ , (see Figure 3, top panel). When averaged across both erotic contents, men reacted with larger changes than did women,  $F(1, 93) = 5.41, p = .02$ . As illustrated in Figure 3, men and women did not differ in electrodermal reactions to other pleasant contexts.

The interaction of sex and stimulus content was marginal in analyses of initial deceleration,  $F(6, 87) = 1.98, p = .08$ , peak acceleration,  $F(6, 87) = 2.05, p = .07$ , corrugator EMG activity,  $F(6, 88) = 2.09, p = .06$ , and dominance ratings,  $F(6, 87) = 1.89, p = .09$ , and these effects were, for the most part, due

<sup>2</sup> Differences among specific picture contents within pleasant and unpleasant valence categories (i.e., main effects of stimulus content) are discussed in Bradley et al. (2001).

Table 2  
*Measures of Cardiac Reactivity During Picture Viewing for Men and Women for Specific Unpleasant, Neutral, or Pleasant Contents*

Content	Initial deceleration <sup>a</sup>		Peak acceleration <sup>b</sup>		IAPS nos.
	Women	Men	Women	Men	
	Unpleasant pictures				
Human attack	-5.82	-5.04	1.03	1.09	3530, 6260, 6350, 6510
Animal attack	-4.86	-3.99	2.80	1.27	1050, 1120, 1300, 1930
Mutilation	-5.58	-4.02*	1.56	0.85	3060, 3080, 3110, 3130
Accident	-4.47	-4.46	2.31	1.60	9050, 9600, 9910, 9920
Contamination	-4.88	-4.88	1.88	1.56	7360, 7380, 9300, 9320
Illness	-5.99	-4.86	1.48	1.45	2710, 3180, 3230, 3330
Loss	-5.58	-4.11	1.40	1.50	2205, 2900, 9220, 9421
Pollution	-4.91	-4.37	2.21	1.98	9110, 9120, 9330, 9830
	Neutral pictures				
Mushroom	-4.43	-2.86*	3.14	3.86	7010, 7030, 7040, 7080
Household Object	-3.97	-2.64*	3.91	3.66	5500, 5510, 5520, 5530
	Pleasant pictures				
Nature	-3.54	-3.45	4.13	3.61	5000, 5760, 5780, 5891
Families	-3.75	-4.75	3.28	1.46*	2070, 2080, 2340, 2360
Food	-4.63	-4.36	4.46	2.43*	7330, 7350, 7400, 7470
Sports	-4.38	-4.30	3.14	2.36	8190, 8200, 8210, 8470
Adventure	-4.28	-3.57	3.09	3.15	8170, 8180, 8370, 8490
Erotic couples	-5.37	-4.21	1.80	1.53	4650, 4660, 4680, 4690
Opposite sex erotica	-5.06	-3.50*	1.63	2.50	4210, 4220, 4250, 4290 <sup>c</sup> 4470, 4490, 4510, 4520 <sup>d</sup>
Same-sex erotica	-4.70	-4.64	1.47	1.15	4470, 4490, 4510, 4520 <sup>c</sup> 4210, 4220, 4250, 4290 <sup>d</sup>

Note. IAPS = International Affective Picture System (Lang et al., 1999).

<sup>a</sup> Scored as the maximum heart rate deceleration in the first 3 s of picture viewing. <sup>b</sup> Scored as the maximum heart rate acceleration in the last 3 s of picture viewing. <sup>c</sup> Data for men. <sup>d</sup> Data for women.

\*  $p < .05$ .

to differences in men's and women's reactions to erotic stimuli. When viewing erotic pictures, women responded with significantly larger corrugator EMG changes (opposite-sex erotica,  $F[1, 93] = 6.46, p < .013$ ; erotic couples,  $F[1, 93] = 4.49, p = .04$ ; see Figure 5, top panel), greater initial deceleration (opposite-sex erotica,  $F[1, 92] = 5.68, p = .019$ ; erotic couples,  $F[1, 92] = 3.52, p = .06$ ; see Table 2), and lower ratings of dominance (opposite-sex erotica,  $F[1, 92] = 4.65, p = .03$ ; erotic couples,  $F[1, 92] = 11.23, p = .001$ ; see Figure 2), compared with men. The single exception was for peak acceleration, in which women responded with greater acceleration than men when viewing pictures of families,  $F(1, 92) = 4.15, p = .04$ ; or food,  $F(1, 92) = 6.32, p = .014$  (see Table 2).

Significant interactions of sex and stimulus content were obtained for orbicularis oculi EMG activity,  $F(6, 88) = 2.53, p = .026$ ; and zygomatic EMG activity,  $F(6, 88) = 2.28, p = .04$ . Differences in facial EMG

activity over these muscles were found primarily when viewing pleasant pictures that did not involve erotic materials, as Figure 5 illustrates. Women reacted with significantly more zygomatic EMG activity (see Figure 5, middle panel) when viewing pictures of families than did men,  $F(1, 93) = 10.88, p = .001$ ; and with more activity in the orbicularis oculi EMG for all nonerotic pleasant contents, including nature scenes,  $F(1, 93) = 10.90, p = .001$ ; families,  $F(1, 93) = 13.25, p < .001$ ; food,  $F(1, 93) = 6.40, p = .013$ ; sports,  $F(1, 93) = 5.31, p = .023$ ; and adventure,  $F(1, 93) = 11.51, p = .001$ .

Across pleasant picture contents, there were no significant effects involving sex in startle reflex modulation, as Figure 4 illustrates. Both men and women showed the smallest startle responses when viewing the most arousing pleasant pictures (i.e., erotic couples and opposite-sex couples), and when pictures were ordered by rated arousal, a comparable linear relationship was obtained for both men and women.

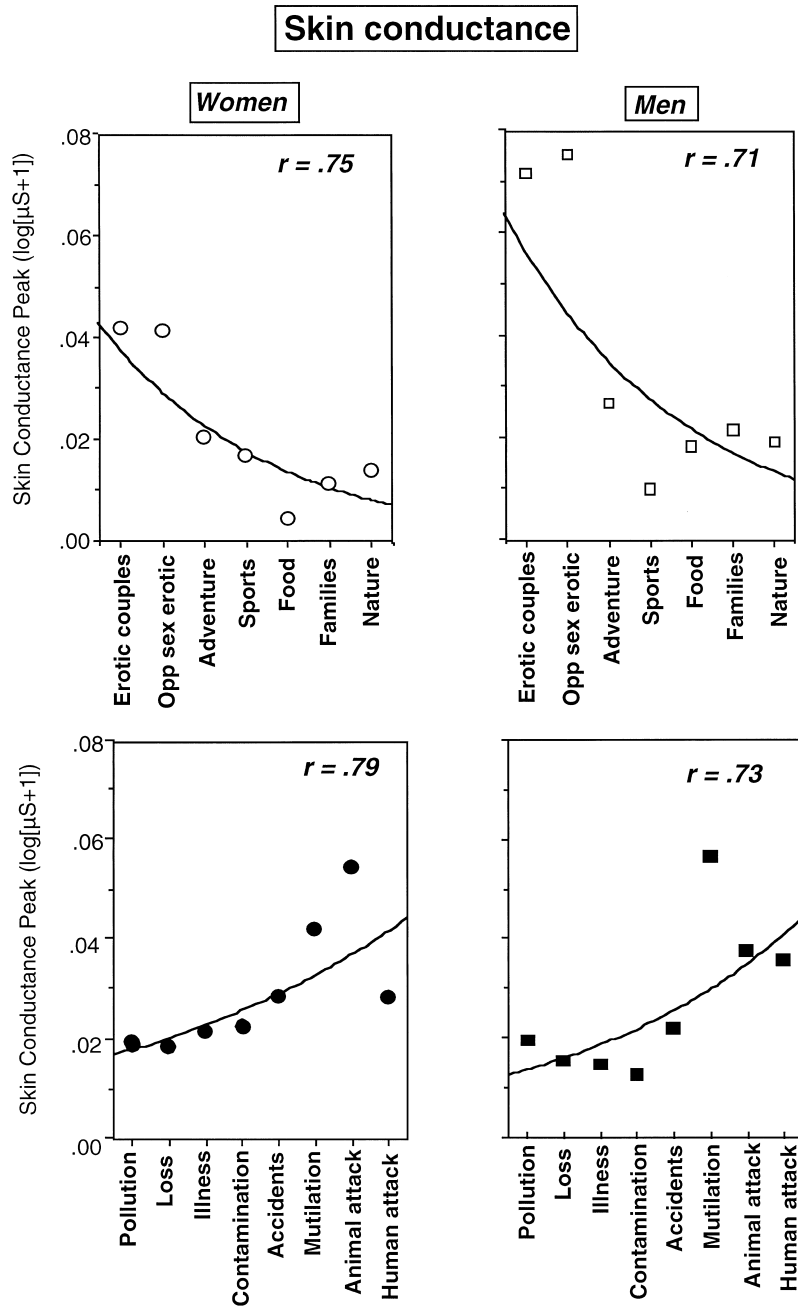


Figure 3. Skin conductance change for women (left panels) and men (right panels) when viewing specific pleasant (open symbols) and unpleasant (solid symbols) picture contents. Opp = opposite.

*Neutral picture contents.* Women showed significantly more initial deceleration to neutral pictures than did men,  $F(1, 92) = 11.08$ ,  $p = .001$ , and this was true when viewing either household objects or mushrooms (see Table 2). For the startle reflex, a

main effect of sex,  $F(1,83) = 10.71$ ,  $p = .002$ , indicated that for men, neutral pictures elicited among the largest blinks in their distributions ( $M = 51.7$  and  $54.0$  for household objects and mushrooms, respectively), whereas this was not true for women ( $M =$

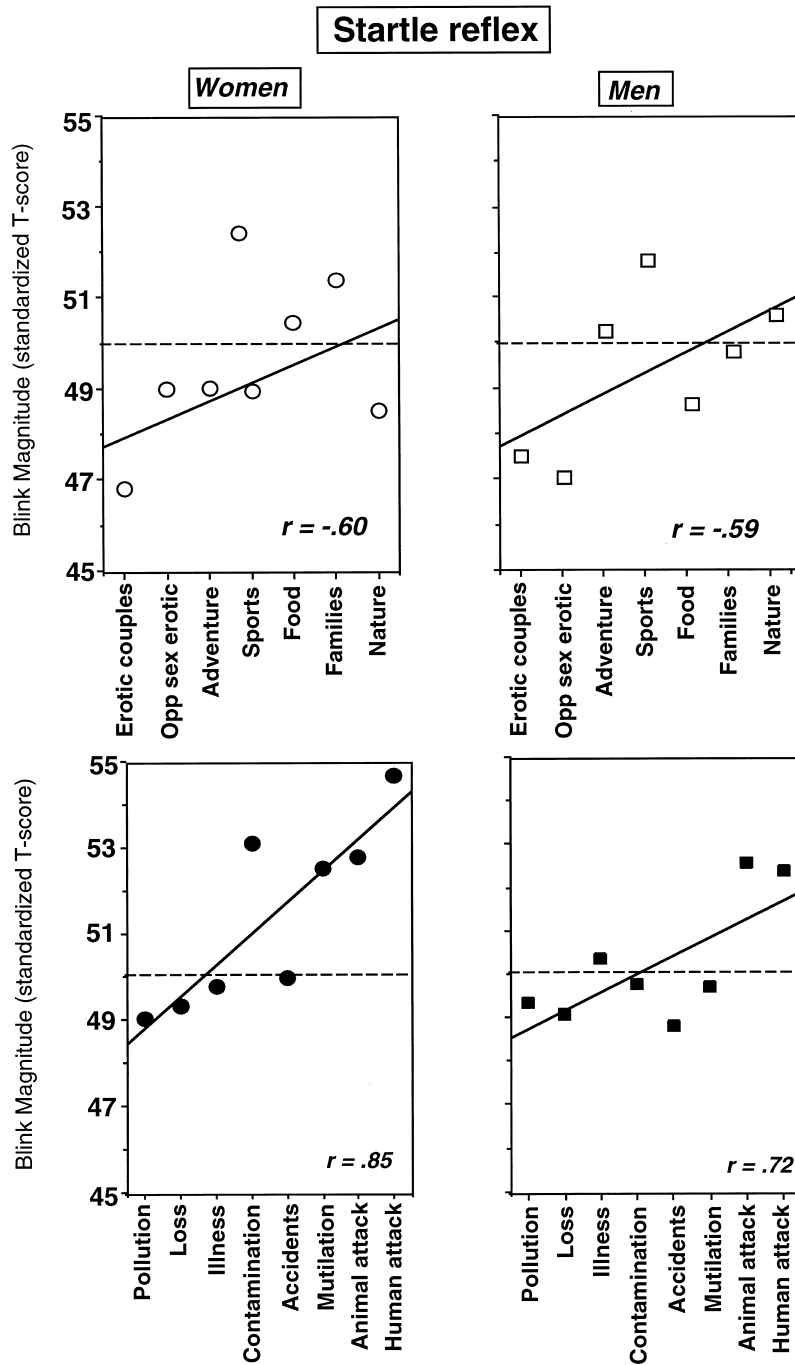


Figure 4. Mean startle blink magnitude for women (left panels) and men (right panels) when viewing specific pleasant (open symbols) and unpleasant (solid symbols) picture contents. Opp = opposite.

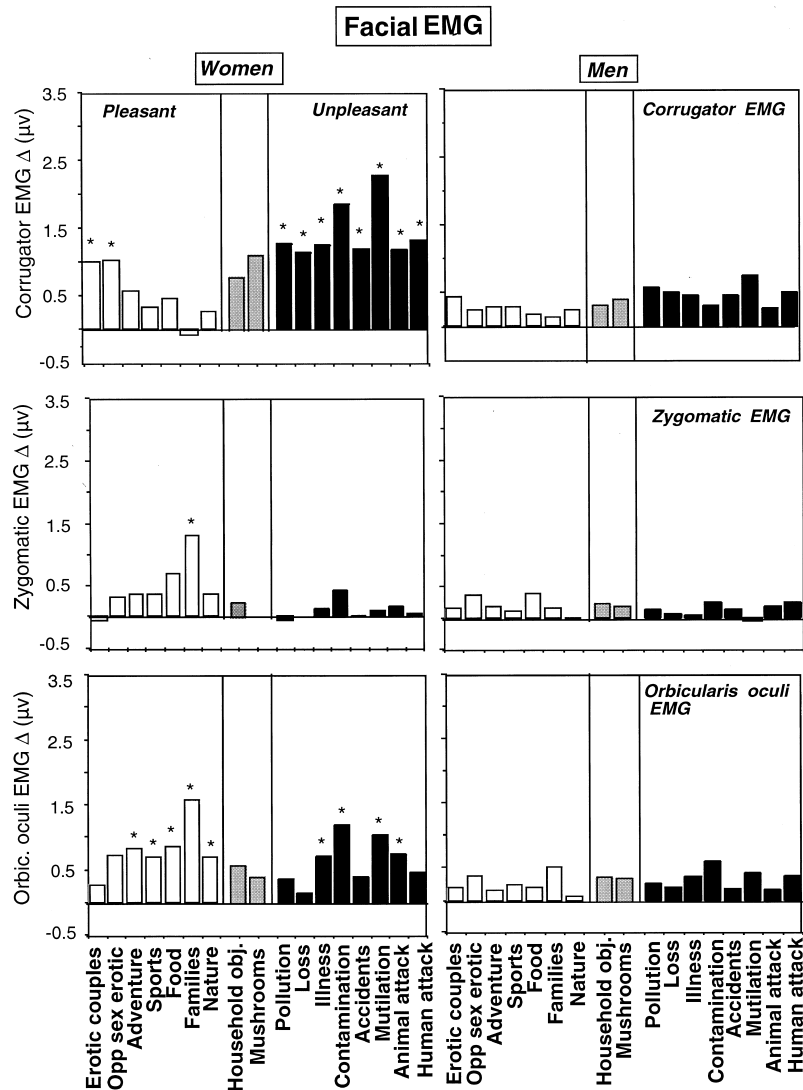


Figure 5. Mean changes in corrugator electromyographic (EMG) activity (top), zygomatic EMG activity (middle), and orbicularis oculi EMG activity (bottom) when viewing specific pleasant (open bars), neutral (shaded bars), and unpleasant (solid bars) picture contents. Asterisks in the left panel indicate significant difference in these facial EMG measures for content when women were compared with men ( $p < .05$ ). Opp = opposite; obj. = object.

49.4 and 49.1 for household objects and mushrooms, respectively). A significant interaction of sex and stimulus content was also obtained for pleasure ratings,  $F(1, 92) = 7.72, p = .007$ , which indicated that women rated mushrooms as slightly less pleasant than did men (see Figure 2).

*Same-sex erotica.* Table 3 lists the means for men's and women's responses when viewing same-sex erotica, as well as the outcome of statistical tests. Women rated same-sex erotica as somewhat more arousing than did men and tended to rate the erotica as slightly more pleasant as well. For both men and

women, however, skin conductance changes when viewing attractively posed same-sex nudes were relatively large and did not significantly differ between the sexes. Women showed more corrugator EMG activity when viewing same-sex erotica than did men, and the magnitude of corrugator EMG changes for women was not significantly different when viewing same-sex erotica as that evoked when viewing unpleasant pictures, with the exception of mutilations,  $F(1, 49) = 12.76, p = .001$ .

Men and women did not differ in their cardiac responses when viewing same-sex erotica; these re-

Table 3

*Mean Ratings of Pleasure, Arousal, and Dominance and Physiological Reactions for Women and Men When Viewing Erotic Pictures of the Same Sex, and Significance Tests*

Dependent variable	Women	Men	Significance test results
Pleasure ratings (1–20)	9.3	8.0	$F(1, 92) = 3.27, p = .07$
Arousal ratings (1–20)	9.2	6.4	$F(1, 92) = 8.65, p = .004$
Dominance ratings (1–20)	11.3	10.2	$F(1, 92) = 1.81, p = .18$
Corrugator EMG $\Delta$ ( $\mu$ V)	1.6	0.7	$F(1, 93) = 5.10, p = .03$
Orbicularis oculi EMG $\Delta$ ( $\mu$ V)	0.5	0.7	$F(1, 93) < 1$
Zygomatic EMG $\Delta$ ( $\mu$ V)	0.2	0.4	$F(1, 93) = 1.16, p = .28$
Skin conductance $\Delta$ ( $\log \mu$ S + 1)	0.04	0.05	$F(1, 92) = 1.53, p = .22$
Initial heart rate deceleration (bpm)	-4.70	-4.64	$F(1, 92) < 1$
Peak heart rate acceleration (bpm)	1.47	1.22	$F(1, 92) < 1$

*Note.* EMG = electromyographic; bpm = beats per minute.

sponses were most similar in both initial deceleration and peak acceleration to those obtained when viewing other erotic pictures (see Table 2). Startle reflexes also did not differ and were as inhibited in magnitude as those elicited when viewing the most arousing, pleasant content (i.e., erotic couples) for both men and women (see Table 3). For women, blinks elicited when viewing same-sex erotica were significantly smaller than those elicited when viewing opposite-sex erotica,  $F(1, 43) = 6.18, p = .017$ .

## Experiment 2

In Experiment 2, we sought to determine whether people select consistent emotional labels for their experience when viewing the different picture contents and, in particular, whether men and women differ in the labels they apply to their emotional experience. The same 72 pictures were shown to a new sample of 135 participants, who were asked to circle as many emotions from a list of 24 different emotion words as were evoked when looking at each picture. On the basis of the sex differences found in Experiment 1, we were most interested in how men and women label their emotional experience when viewing unpleasant picture contents, as well as when viewing pictures of erotic stimuli.

### Method

*Participants.* There were 135 (82 women and 53 men) participants from a University of Florida introductory psychology class who received course credit for taking part in this study. Sessions were conducted in small groups varying from 6 to 15 participants.

*Materials and design.* The materials were the same as described in Experiment 1. The 72 pictures (18 categories with four exemplars each) were divided into two sets of 36, with two exemplars from each of

the 18 stimulus contents in each set. Each participant viewed one of the two sets of 36 pictures. Seventy-one participants (46 women, 25 men) viewed and rated one set of pictures, and 64 participants (36 women, 28 men) viewed and rated the second set. Pictures were ordered in blocks of 18, such that there was one exemplar from each of the 18 contents in each block of 18 (as well as 4 pleasant, 1 neutral, and 4 unpleasant within each half-block of 9) and with the constraint that no more than 3 pictures of the same hedonic valence were presented consecutively. Four different presentation orders were constructed, such that each picture was presented equally often, across orders, in each quartile.

Each participant received a 36-page booklet, in which each page began with the phrase, "When I looked at the picture, it made me feel:" and was followed by a list of 24 emotions presented in four columns and six rows. Among the emotions listed were the following: *angry, afraid, bored, sad, pity, anxious, irritated, disgusted, impatient, unhappy, confused, embarrassed, happy, hungry, loving, sexy, excited, romantic, nurturant, satisfied, comfortable, free, playful, and amused*. Four different page orders were created in which the appearance of each word in each column was counterbalanced. Each booklet was arranged in subblocks of four pages, with one page from each of the four counterbalanced orders.

*Procedure.* The procedure involved a 6-s picture presentation, followed by the ratings. Five seconds before each picture appeared, an instruction slide was presented that indicated the correct number in the ratings booklet for the upcoming picture (e.g., "Please rate the next slide on page X."). The participant was told to turn to the specified page. Then, a picture was presented for 6 s, and the participant was instructed to simply view the picture while it was on the screen.

After the picture was removed, participants were instructed to circle any of the listed emotions that they may have felt while viewing the picture; 15 s was allocated for the rating. This procedure continued until all the ratings were made, after which the participants were debriefed, given credit, and thanked.

For each participant, the proportion of pictures in each content category endorsed with a specific emotion descriptor was determined, and these proportions were averaged across participants for each picture content.

### Results

Table 4 lists the mean proportion of trials on which men and women endorsed a specific emotion as descriptive of their emotional response when viewing pictures in each of the 18 stimulus contents investigated in this study. Emotions endorsed on less than 10% of the trials by participants are not listed. As Table 4 illustrates, a variety of different emotion descriptors were typically selected when viewing each content. For analysis purposes, the two emotions selected most frequently were included in an ANOVA that included sex (men, women) and specific emotion (two levels) and are highlighted in Table 4.

In general, there was good agreement between men and women concerning which emotions were selected, although there were several notable differences. When viewing pictures of erotic couples, both men and women reported feeling sexy and romantic and did not differ significantly in the proportion of trials these feelings were reported. Conversely, men and women diverged in their reports of emotional experience when viewing erotic pictures of the opposite sex, with a higher proportion of men endorsing sexy and excited, whereas women reported feeling amused and embarrassed, and with less agreement among themselves. For adventure pictures, men and women both reported feeling excited and free. Although these emotions were also selected to describe emotional reactions to sports pictures, men reported them significantly more often than did women,  $F(1,129) = 5.28, p = .02$ .

Men and women did not differ in their reports of feeling primarily happy when viewing pictures of food, with a secondary listing of excited for men and satisfied for women, although each of these was reported somewhat less frequently than reports of happiness,  $F(1, 77) = 16.17, p < .001$ , for women;  $F(1,52) = 3.42, p = .07$ , for men. Men and women agreed in selecting "happy" and "love" when viewing pictures of families and babies, but both of these emo-

tions were endorsed more often by women compared with men,  $F(1, 129) = 16.21, p < .001$ . Similarly, whereas both men and women reported feeling happy and free when viewing nature pictures, women reported feeling these more often than men,  $F(1, 129) = 16.48, p < .001$ . For both men and women, feeling free was more frequently selected as the elicited emotion than feeling happy when viewing pictures of nature,  $F(1, 129) = 14.58, p < .001$ .

For unpleasant pictures, both men and women reported feeling afraid and angry when viewing pictures of human threat. However, a significant interaction between gender and emotion,  $F(1, 129) = 8.38, p = .004$ , indicated that although men and women did not differ in their reports of feeling angry, women were significantly more likely to endorse feeling afraid when viewing these threatening pictures,  $F(1, 129) = 22.89, p < .001$ . Similarly, for pictures of animal threat, both men and women reported feeling afraid and anxious, but a significant interaction of gender and emotion,  $F(1, 129) = 4.22, p = .04$ , indicated that women were more likely to report feelings of fear compared with men,  $F(1, 129) = 16.67, p < .001$ , whereas men and women did not differ in their reports of anxiety. Both men and women, however, were more likely to report feeling fear than anxiety when viewing pictures of threatening animals,  $F(1, 77) = 40.73, p < .001$ , for women;  $F(1, 52) = 10.64, p < .005$ , for men.

Pictures of mutilation elicited feelings of disgust in men and women equally often and secondarily, feelings of pity and sadness, which did not differ between men and women. Pictures of contamination and pollution elicited reports of disgust and irritation from both men and women. Women tended to be more likely to report these feelings when viewing pictures of pollution, however,  $F(1,22) = 4.12, p = .06$ . Pictures of accidents, illness, and loss all elicited feelings primarily of pity and sadness from both men and women, but for pictures of illness, these emotions were reported significantly more often by women compared with men,  $F(1, 129) = 6.98, p = .009$ .

There were no differences between men and women in reports of emotions when viewing neutral pictures. Both reported feeling primarily bored and then confused (.56 and .22 for household objects; .34 and .28 for mushrooms), with higher reports of boredom than confusion for household objects,  $F(1, 129) = 49.43$ , but not for mushrooms. When viewing same-sex erotica, men and women also reported feeling bored and confused, again, with more frequent

reports of boredom than confusion,  $F(1, 129) = 14.08, p < .001$ .

### General Discussion

As expected, affective pictures elicited measurable emotional reactions in both men and women. The pattern of modulation in the autonomic, somatic, reflex, and evaluative systems measured here was quite similar, with both men and women most reactive to contents depicting threat, mutilation, and erotica—cues that are held to strongly activate the defensive and appetitive motivational systems underlying emotional experience. Nonetheless, the data are consistent with hypotheses that women are more defensively reactive, whereas men are specifically more aroused by erotic pictures. These sex differences influence the shape of the affective space formed by men's and women's judgments of pleasure and arousal: For women, unpleasant pictures adhere closely to a steeper, more strongly linear, defense motivation vector than is found for men; conversely, for men, the vector for appetitive motivation is steeper and more strongly linear than for women. These differences in the shape of affective space for men and women are also found when people rate sounds or words (Bradley & Lang, 1999a,b). These evaluative judgments, of course, can be shaped through social learning and reinforcement. The concordance of evaluative reports with autonomic and reflex measures, however, suggests that differential cue reactivity in men and women may be, in part, biologically determined.

#### *Defensive Motivation*

Reports of more intense displeasure and greater facial EMG activity were obtained for women irrespective of specific, "unpleasant" content, supporting hypotheses that women are generally more emotionally expressive when processing aversive cues. There were also indications of heightened defensive reactivity for women in measures less amenable to voluntary control. Women responded with greater fear bradycardia (cardiac deceleration) when viewing unpleasant pictures, again irrespective of the specific aversive content. *Fear bradycardia* is interpreted as indicating the heightened attention and sensory intake that occurs when the defensive system is alerted, but activation is relatively low. For women, this index of defensive activation was greater than men even for unpleasant contents rated as low in arousal. And although men and women were equivalent in absolute magnitude of electrodermal responses when viewing

unpleasant pictures, compared with other picture contents, only women showed the most heightened reactivity for unpleasant pictures.

Modulation of the startle reflex—an index of defensive mobilization—was generally similar for men and women, with the largest reflexes elicited in the context of cues depicting threat and death. The pattern of modulation differed, however, across specific contents: Women showed a general increase in blink magnitude to unpleasant pictures and clear potentiation for the most highly arousing picture contents (relative to blinks elicited when viewing neutral pictures), whereas men showed a relative inhibition for unpleasant contents rated moderate in arousal (e.g., pollution, loss, illness, accidents), with "heightened" reflexes only when viewing pictures depicting imminent attack.

Interpreted from the perspective of the defense cascade model (Lang, Bradley, & Cuthbert, 1997), these data suggest that symbolic picture cues activate the defensive motive system more intensely in women than in men, as evidenced by greater attention (as measured by sustained cardiac deceleration) and clear priming of the defensive startle reflex. Furthermore, these reflexive responses were accompanied by judgments of greater displeasure and stronger negative facial displays, indicating a consistent, markedly negative reaction to aversive stimulation. For men, however, evidence suggests that unpleasant pictures were less defensively activating. Increased orienting (as indicated by moderate cardiac deceleration and inhibited startle reflexes) was the predominant reaction to all but the most arousing unpleasant contents.

These different patterns of reactivity are broadly similar to those obtained in a recent study investigating children's (7–10 years old) affective reactions to pictures. In this research, girls responded more defensively in evaluative judgments, facial expression, and reflex potentiation than did boys (McManis, Bradley, Berg, Cuthbert, & Lang, 2001). Whether these differences reflect biological or sociocultural factors cannot be determined here; however, finding similar sex differences early in development is compatible with a biologically based view (Manstead, 1992). In any event, it is clear that women are highly concordant in responding to aversive cues—across evaluative, autonomic, and reflex measures—and show this responsiveness to a broad range of stimuli, consistent with a stronger disposition to engage the defensive motivational system.

That women may be more reactive to aversive stimulation is consistent with other social and clinical



Table 4 (Continued)

	Pollution		Loss		Illness		Contamination		Accidents		Mutilation		Animal attack		Human attack	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Pleasant																
Loving			.11													
Excited													.11	.31	.21	
Amused															.15	
Nurturant					.16											
Unpleasant																
Bored	.13	.10														
Pity	.19	.25	<b>.56</b>	<b>.59</b>	<b>.67</b>	<b>.58</b>			<b>.55</b>	<b>.50</b>	.41	<b>.42</b>	.13	.14		
Confused	.22	.24	.18	.15	.21	.13	.13		.27	.12	.33	.27	.25	.16		
Irritated	<b>.43</b>	<b>.26</b>	.11	.10	.31	.26	<b>.50</b>	<b>.42</b>	.22	.12	.27	.20	.33	.30		
Sad	.24	.21	<b>.79</b>	<b>.61</b>	<b>.69</b>	<b>.51</b>	.17	.16	<b>.63</b>	<b>.49</b>	<b>.47</b>	.40	.19	.13		
Angry	.22	.18	.12	.17	.37	.18	.17	.16	.22	.12	.19	.15	<b>.42</b>	<b>.35</b>		
Afraid	.15	.11	.17	.17	.22	.12			.53	.32	.36	.15	<b>.67</b>	<b>.37</b>		
Anxious	.12				.10		.11		.22	.16	.21	.10	.33	.30		
Disgust	<b>.56</b>	<b>.34</b>			.38	.41	<b>.88</b>	<b>.78</b>	.19	.12	<b>.81</b>	<b>.75</b>	.19	.16		
Impatient	.11						.14									

Note. The two labels selected most frequently across participants are highlighted in bold. F = female participants; M = male participants.

research. As Marks (1969) noted, "women consistently report more fear than do men on fear schedules" (p. 78), and considering epidemiological studies of anxiety disorder, "there are hardly any phobias which men manifest consistently more than women . . ." (p. 75). Although certainly open to a cultural explanation, the ubiquity of greater fearfulness in women suggests intrinsic factors, perhaps related to differences in hormonal balance, physical size, and strength. Whether ultimately attributed to biology or culture, or both, the data presented here are consistent with the notion that picture stimuli prompt somewhat greater defensive activation in women than men, whereas for men, unpleasant pictures, particularly those representing low personal threat, mainly prompt interest and attention.

### *Appetitive Motivation*

Reactions to scenes representing life's joys and pleasures were remarkably similar for men and women, with erotic scenes prompting the most intense reactions in all measures for both sexes. Sexual cues represent primary reinforcers that directly engage the appetitive system. These cues also have consistent impact across individuals, unlike the idiosyncratic pleasures inherent in, for example, different sports or recreational activities. Only pictures of erotica appeared to reach the threshold necessary for additional sympathetic activation over the obligatory orienting response (see Bradley et al., 2001). Consistent with previous research (Koukounas & McCabe, 1997; Steinman, 1981), men showed these effects more strongly than women. Men reported more intense pleasure and arousal when viewing erotic stimuli and reacted with greater sympathetic arousal (as measured by palmar conductance) as well. Furthermore, heightened arousal was evident only for erotica. Men did not react more intensely than women to any other arousing appetitive content.

The pattern of startle modulation when viewing pleasant pictures was remarkably similar for the two sexes, with the most inhibited reflexes elicited in the context of erotic picture viewing, consistent with high appetitive motivation. Responses in other measures, however, suggested that women responded to erotic stimuli with mixed motivation. Like reactions to unpleasant pictures, erotic pictures evoked measurable corrugator EMG changes, lower ratings of dominance, and increased cardiac deceleration in women, compared with men. Moreover, whereas men reported feeling sexy and excited when viewing erotic pictures of the opposite sex, women reported feeling primarily amused and embarrassed.

Again, the relative influence of biological and sociocultural factors on men's and women's reactions to erotic stimuli cannot be determined here, particularly in terms of men's heightened arousal to visually presented erotica. From a social-learning view, it is possible to entertain hypotheses that emotional expression in the context of sexual stimuli is accepted and perhaps reinforced for men, but not women, in Western culture. However, the idea that these young men are in a culture that encourages them to seek erotic stimulation, for example, through magazines, is inconsistent with the predominantly Judeo-Christian heritage in Western societies. That men may be specifically more reactive to visual depictions of erotic stimuli is supported by the number of commercial magazines dedicated to this enterprise, the relative absence of these materials for women, and research indicating that women consistently report less arousal in this erotic context.

Sociobiological theorists (e.g., Buss, 1994) hypothesize that physical (visible) and nonphysical features of potential mates are differently appealing to men and women because of differences in the relative costs entailed by sexual activity. For men, who are required to neither carry nor necessarily care for potential offspring, physical features and relative youth are important criteria in determining sexual action. These are attributes that are easily apprehended with visual cues. For women, however, on whom a significant portion of the burden of childbearing and childrearing falls, nonphysical features such as resourcefulness and commitment may be more important in controlling potentially critical sexual activities. Data indicating the primacy of physical and nonphysical characteristics in men's and women's choices of mates support this conceptualization (Bereczkei, Voros, Gal, & Bernath, 1997; Stewart, Stinnett, & Rosenfeld, 2000; Surbey & Conohan, 2000; Townsend & Levy, 1990). Regardless of the ultimate explanation, the data obtained here suggest that although erotic stimulation through visual cues activates appetitive motivation in both men and women, this activation is more intense for men.

### *Facial Expressivity*

The nonspecific hypothesis that women are generally more facially expressive than men (e.g., Buck, 1984; Schwartz et al., 1980; Zuckerman & Larrance, 1979) can be refined on the basis of the data acquired here. Unpleasant pictures elicited measurable corrugator EMG activity in men (e.g., relative to viewing neutral pictures), suggestive of a frown, and the pat-

tern of EMG changes across different unpleasant contexts was not significantly different for men and women, with, for instance, the greatest activity occurring in response to pictures depicting mutilation and death. Conversely, whereas women reacted with measurable increases in activity over the zygomatic and orbicularis oculi muscles when viewing pleasant pictures, indicative of smiling, men did not. Taken together, these data indicate that when viewing unpleasant materials, women frown more than men. Conversely, when viewing pleasant stimuli, men smile less than women.

Although there is no theoretical consensus explaining this phenomenon, several investigators have suggested that differences in emotional expression are related to social expectations based on different gender roles. LaFrance and Hecht (2000), for example, proposed that the norms governing the use of facial displays, particularly smiling, are different for men and women, with greater social expectations for women to smile, as well as more reinforcement for smiling behavior. These socially defined rules are proposed to arise based on gender roles in which, for instance, women are more frequently involved in nurturing and caregiving activities where smiling is an effective instrumental behavior. This hypothesis is especially interesting in view of the fact that pictures of families and babies elicited the most smiling behavior in the college women assessed here.

Conversely, there is evidence that expressions of displeasure, particularly fear, are discouraged in boys and men (Brody, 2000), based on their expected roles in positions of power and strength, in which displays of weakness (e.g., threat) are dysfunctional. Taken together, these social proscriptions would encourage women to smile and discourage men from frowning. Socialization notwithstanding, however, the current data indicate that unpleasant pictures prompted measurable facial reactions in men, evidencing perhaps society's ability to attenuate, but not eliminate, reflexive facial displays to potentially threatening cues.

#### *Discrete Emotions*

A relatively wide range of emotions was typically endorsed when viewing specific picture contents, with pictures of attack, for instance, prompting reports of fear, anxiety, sadness, anger, and pity. In general, labeling of discrete emotions was fairly consistent across men and women. Replicating previous research (Nolan & Ryan, 2000), women were more likely to report fear when viewing pictures depicting threat, consistent with a view that men are discouraged from

expressing fear. As noted above, men and women also apply very different descriptors to their emotional experience when viewing erotic members of the opposite sex. As with other evaluative judgments, however, the selection of appropriate words to describe one's emotional experience is highly influenced by social expectations and norms: Although both men and women were highly reactive to pictures of members of the same sex in erotic poses, both reported feeling primarily bored when viewing these pictures.

The aversive content most reliably labeled as evoking a specific emotion involved pictures of contamination (e.g., spoiled food, vomit) and mutilated bodies, which on a sizable number of trials were reported as evoking disgust. These pictures were also rated as relatively high in arousal and prompted sustained cardiac deceleration, large electrodermal and reflex reactions, and a facial expression consistent with one of disgust (e.g., concurrent increases in activity over corrugator, zygomatic, and orbicularis oculi muscles). Notably, these are some of the first data indicating that pictures that elicit reports of disgust (i.e., rather than facial expressions of disgust) are potent in eliciting affective reactions in both men and women.

#### *Summary*

Both men and women react to pictures depicting highly arousing contents of threat, mutilation, and death, as expected if basic motivational dispositions are similarly organized for mammals at survival risk in the natural environment. For pictures depicting less arousing appetitive and defensive contexts, men and women also showed remarkable congruence in their physiological profiles. Nonetheless, the pattern of response across evaluative reports, facial EMG activity, cardiac orienting, and reflex modulation when women viewed unpleasant pictures, irrespective of specific content, suggests a broad disposition to respond with greater defensive activation for these aversive cues. Conversely, men were particularly reactive to visual pictures involving erotic stimuli.

Biological and sociocultural factors may both play roles in modulating the reactions of men and women in affective perception. Cross-cultural studies, especially those investigating men and women raised in nontraditional Western societies, as well as additional developmental research, would assist in determining the impact of biological-genetic or sociocultural variables in affecting men's and women's reactions to affective cues. Moreover, the fact that female rats also consistently show greater defensive reactivity in

threatening contexts than do male rats (Blanchard, Shepherd, de Padua Carobrez, & Blanchard, 1991; Crabtree & Moyer, 1973; Shepherd, Rodgers, Blanchard, & Magee, 1993) suggests that animal research may also help to elucidate the causal contributors to differential emotional reactivity. The data acquired here, however, also demonstrate that despite specific sex differences, men and women are quite similar in their affective reactions to a variety of pictures depicting life's pleasant and unpleasant events.

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