GENDER DIFFERENCES IN FACIAL EXPRESSIONS OF EMOTIONS

HUMBOLDT STATE UNIVERSITY

by

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ABSTRACT

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The aim of the present study was to investigate gender differences in the facial expression of emotion using electromyographic (EMG) recordings taken while participants viewed emotional stimuli. Facial EMG activity was recorded on the zygomaticus major and corrugator supercilii muscles, located below and above the eyes respectively. Self-report assessment was used as an index of experiential emotions. The study included two trials: in the first trial, participants were asked to view pleasant and unpleasant photographs as positive and negative emotional stimuli; in the second trial, participants were shown film clips conveying anger, happiness, and fear as specific emotional stimuli. In the first trial women showed more intense facial expression than men, as evinced by significantly higher zygomaticus activity ($p < .01$) that occurred when viewing pleasant photographs, and higher activity on the corrugator ($p < .01$) while viewing unpleasant photographs. Women also reported stronger emotional experiences than men, but only when reflecting upon unpleasant photographs ($p < .01$). In the second trial, women were found to be more facially expressive than men, as indicated by increased activity on the zygomaticus major ($p < .01$) while watching films conveying happiness, and increased activity on the corrugator ($p < .05$) while watching films conveying fear—however, the genders did not differ in the intensity of facial expression for films conveying anger. Compared with

men, women reported experiencing more intense feelings of fear ($p < .05$), but did not differ in reports of anger and happiness. The results of these findings provided initial support for evolutionary predictions of gender differences in facial expression of emotions, but offer no evidence for differences in experiential emotions, except fear.

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INTRODUCTION

Gender differences in psychology are interesting areas of study which have involved a great deal of investigational research from various perspectives in modern society. Previous studies agree, compared with men, women are more emotional (e.g., Allen & Haccoun, 1976; Allen & Hamsher, 1974; Balswick & Avertt, 1977; Larsen & Diener, 1987). However, what is written on the topic appears overly general and lacking in detail. Emotion is a mental dynamic which drives spontaneous feeling and also drives spontaneous expression (Darwin, 1872), so we must consider two domains of emotion: one is emotional experience and the other is emotional expression. The present study focused on these two domains while gender differences in the facial expressions of emotions, as well as the inner experience of self-perceived feeling were investigated.

Regarding emotional experiences, earlier researches on self-reporting have shown that compared with men, women report experiencing more extreme feelings, and are more likely to look for consolation from others (Allen & Haccoun, 1976; Allen & Hamsher, 1974; Balswick & Avertt, 1977; Larsen & Diener, 1987). On the other hand, emotional expression refers to how individuals communicate their emotions via verbal and nonverbal behaviors with unconscious or conscious affect (Kring, Smith, & Neale, 1994). Different measurements of emotional expression have been used in previous studies, for instances recording electromyography (EMG) (e.g., Lang, Greenwald, Bradley, & Hamm, 1993; Schwartz, Brown, & Ahern, 1980), rating facial expressions by

self-report (e.g., Barr & Kleck, 1995; Halberstadt, Hayes, & Pike, 1988) and examining the precision of communication (Wagner, Buck, & Winterbotham, 1993). For the most part, previous studies have demonstrated women show stronger emotional expressions than men (e.g., Ashmore, 1990; Brody & Hall, 1993; Hall, 1984), though some studies have failed to discover significant difference between men and women (Fridlund, 1991; Vrana, 1993).

The current study proposed to examine gender differences in terms of facial expressions (the major form of emotional expression) and self-report of feelings (representing emotional experience) in order to focus on two questions: (a) whether women show stronger facial expressions and experience more intense emotions than men, and (b) whether men and women have different experience and facial expression for the specific emotions of happiness, anger and fear.

Facial Expressions Communicate Emotions

If one imagines experiencing fear, one will probably frown or show signs of alarm. Likewise, when one imagines experiencing happiness, one will most likely smile and show signs of joy. The face is like a window into the emotional experience of an individual. Aristotle (1913) wrote, “There are characteristic facial expressions which are observed to accompany anger, fear, erotic excitement, and all the other passions” (p. 808). It is accepted that facial expression in a relation to emotional cognition is innate (Darwin, 1872), though at times people may attempt to deceive others by expressing emotions other than the true inner condition they are experiencing.

Darwin is the first researcher to work with empirical research of facial expression. In his book, *The Expression of the Emotions in Man and Animals* (1872) Darwin said that human expressions of emotion are an evolutionary development from separate animals' parallel expressions. He suggested that facial expressions of emotions are untrained reactions which comprise complicated series of facial muscles movements (Dimberg, 1990). Darwin's evolutionary view has been extended in the research of gender difference on emotion in no less than three decades. Numerous recent theories of emotion have incorporated this idea proposing at least seven basic emotions: anger, disgust, fear, happiness, sadness, surprise, and contempt (e.g., Ekman, 1973; Izard, 1977).

A great deal evidence supports the hypothesis that basic emotions can be distinguished by different facial expressions (e.g., Ekman, 1993). Activation of the complicated set of facial muscles offers the basis of displaying different facial expressions of emotion (Dimberg, 1990). The western and Eastern investigations have found consistent evidence that people chose similar emotional terms to match facial expressions regardless of their culture (Dimberg, 1990; Ekman & Friesen, 1971). Several studies have substantiated that facial expression, as a biological function, is related to emotion (e.g., Rosenberg & Ekman, 1994), albeit some study argues that facial expression is not relevant to experiential emotion, such as non-Duchenne smile with only elevating the corner of your mouth doesn't reflect true happiness instead of Duchenne smile with lifting up your cheek and shaping the wrinkles around your eyes show genuine joy (Duchenne, 1990; Fernandel-Dols & Ruiz-Belda, 1995). The face, by expressing nonverbal signals, is able to convey emotions (Ekman, 1997; Ekman, Friesen, & Ancoli,

1980; Fridlund, 1991), meaning almost every society uses the same facial expressions to show the basic emotions (e.g., Ekman, 1993; Ekman & Friesen, 1971; Ekman, Friesen, & Ellsworth, 1982).

Facial electromyography (EMG)

It is the innateness of emotional facial expression that allows facial electromyography (EMG) recording to be used as a reliable read-out of emotional expression. Though directly watching facial expression is a traditional way for the observer to judge emotions, EMG recoding as a quantitative method provides a precise unbiased measures of muscle activity (Dimberg, 1990). Compared with observational assessment, EMG recording can detect even the most minute muscles movements in emotional progression (Cacioppo, Martzke, Petty, & Tassinary, 1988; Cacioppo, Petty, Losch, & Kim, 1986; Dimberg, 1990; Hu & Wan, 2003; Vrana, 1993). Several previous researchers have found that EMG activity on different facial muscle patterns in response to distinct motional experiences (Cacioppo & Petty, 1981; Fridlund & Lzard. 1983; Schwartz, Ahern, & Brown, 1979; Zhou & Hu, 2006). For example, earlier studies have verified that when pleasant feelings were imagined, EMG activity was amplified on the zygomaticus major to create a smile. Conversely, when unpleasant feelings were imagined, EMG activity was increased on the corrugator to wrinkle the brow (e.g., Hu & Wan, 2003; Lang et al., 1993; Schwartz et al., 1980).

The earliest study of emotion associated with facial muscles activity allowed separating specific emotional situations such as imagined happiness, sadness and anger,

or “a typical day” by using EMG recording on “corrugator, frontails, depressor and messeter” muscles (Schwartz, Fair, Salt, Mandel, & Klerman, 1976, p. 490). Consistent with Darwin’s hypothesis that the movements of facial muscles represent emotional productions, the previous research on these muscles provided the origin of diverse emotional facial expression (e.g., Darwin, 1872; Ekman, 1973; Izard, 1977). In the present study, we measured facial expression by EMG recording of the zygomaticus major and corrugator supercilii activity during stimulus presentation.

Gender Differences of Emotion

The evolutionary perspective of adaptive pressures indicates men and women are different in regard to negotiating status hierarchies (Darwin, 1896). Darwin (1896), however, did agree that women excelled over than men in some areas, for instance superior tenderness, stronger instinct and faster perception. Evolutionary psychology predicts that because men and women have dealt with disparate adaptive tasks over the period of evolution, men and women dominate different areas (Buss, 1995).

Parental investment theory refers to parents (men and women) contributing differing amounts of time and effort when rearing their offspring (Trivers, 1971). Women contribute more reproductively, indicated by the few eggs produced by the female vs. the vast numbers of sperm produced by men, pregnancy, and producing milk to feed children. The greater contribution of women results in an evolutionary shift toward responsibility for rearing children and increases the likelihood of their offspring to living long enough to reproduce (Babchuk, Hames, &Thompson, 1985). In order to rear

children effectively, women are more perceptive and responsive to nonverbal signals because it is an important skill when communicating, especially with infants who are not yet able to talk (Hall, 1984). In other words, to enhance child-bearers efficiency, women are more likely to be able to sense and respond to others' feelings and emotional expression (Broverman, Vogel, Broverman, Clarkson, & Rosenkrantz, 1972).

A number of findings are consistent with the evolutionary explanation of gender differences (e.g., Hampson, van Anders, & Mullin, 2006). Across almost all cultures, when examining gender roles on everyday basis activities, women take part more often in family affairs that need rapid receptiveness and strong responsiveness to emotion (e.g., Crano & Aronoff, 1978). In addition, Crano and Aronoff (1978) investigated an international sample with 186 societies revealing that women, as mothers, offered more emotional support to children during the ages of one to five years old than did fathers. Female offspring, spouses, and related in-laws all take a greater responsibility for taking care of children and older adults than males (Horowitz 1985; Stone, Cafferata, & Sangl, 1987). These findings suggest women have been selected to improve capabilities and beliefs in emotional perception and self-expression. Due to these implications, we expected women to show stronger facial expressions, and to report more intense emotional experiences, than men when reflecting upon emotional stimuli in the first trial.

Gender Differences in Facial Expressions of Specific Emotions

At least seven fundamental emotions (anger, disgust, fear, happiness, sadness, surprise and contempt) exist (e.g., Ekman, 1973; Izard, 1977). Previous research on

gender differences found that compared with men, women show stronger expression of disgust, fear, sadness, surprise and happiness (e.g., Allen & Haccoun, 1979; Balswick & Avertt, 1977; Barr & Kleck, 1995; Fujita, Harper, & Wiens,1980; Kring & Gordon, 1998; Rotter & Rotter, 1988; Schawrtz et al., 1980; Wagner, Buck, & Winterbotham, 1993). Even though earlier studies showed that women exhibit stronger expressions than men of almost all basic emotions (e.g., Ashmore, 1990; Brody & Hall, 1993; Hall 1984), previous studies are inconsistent whether women more strongly express all basic emotions or merely specific emotions than men do. Therefore, a further study on this issue is needed. In the second trial gender differences were examined for the specific facial expressions and experiences of happiness, anger, and fear.

Happiness

Babuchuk et al. (1985) proposed the "primary caretaker hypothesis" extending from parental investment theory, to explain the gender difference in facial expression and cognition. As primary caretaker, women communicate with their children more often and more effectively than men (Hampson et al., 2006). In addition, Hall, Lamb, and Perlmutter (1986) provided the "attachment promotion hypothesis" as one account of "primary caretaker hypothesis" which predicts that women respond strongly to babies' emotional signals, especially facial signals, in order to give their offspring the experience of a safe emotional bond and the promise of a life in good condition, which suggests that women show stronger facial expressions and higher facial recognition of emotion than men do. Because positive emotional experience and expression are crucial for caretakers

to develop and maintain good relationships with others, women are believed to express more positive emotions than men in most cultures (Stoppard & Gunn Gruchy, 1993). Girls are most often prompted to express positive emotions in support of in women's roles of fosterer and caretaker (Parsons, 1955). For example, Fivush (1989) explored 18 women's discussions with their 30 to 35-month-old babies (half were females and half were males) about experiences related to emotional components. On the one hand, mothers concentrated on positive emotions but avoid talking about negative emotions, especially anger, with the daughters; conversely, mothers talked about positive and negative emotions equivalently with sons.

Consistent with the predictions of evolutionary psychology, previous studies show that woman reported more intense emotional experience while responding to the pleasant photographs of infants (Grossman & Wood, 1993; Lang et al., 1993). In international surveys, women reported more intense experiential happiness and showed stronger expressions than did men (Allen & Haccoun, 1976; Brody, 1996). As mentioned before, unprejudiced facial EMG recording is a dependable read-out of emotional expression. Proving this point is the finding that gender differences in facial EMG activity are generally in agreement with previous nonverbal studies which found that woman displayed stronger facial expression of emotion than men (Barr & Kleck, 1995; Halberstadt et al., 1988). Based on aforesaid conclusions, we expected women would show stronger facial expressions of happiness, and report more intense feelings of happiness than men when responding to happy-eliciting stimuli in the second trial.

Fear

Fear is “designed to detect danger and produce responses that maximize the probability of surviving” (LeDoux, 1996, p. 128). Fear is also “a situated emotion that can directly restrain aggressive behavior” (Campbell, 2006, p. 242). Fear expression is mainly elicited by approaching personal danger from interpersonal aggression or non-personalized threat (Hanger & Ekman, 1983). The facial expression of fear is a signal of suffering which is easy to display and recognize among almost every culture (e.g., Darwin, 1872; Ekman, 1973).

Women are more likely to feel afraid than men (Campbell, 1999). As the primary caretaker, women need to protect them from danger and remain alive in order to be able to continuously provide effective care to their children (Campbell, 1999). Biologically speaking, Kirschbaum and Hellhammer (1994) suggested this occurs because, compared with men, women produce more cortisol while facing aggressive circumstances. Another explanation of “primary caretaker hypothesis, the “fitness threat” hypothesis indicated when facing threat, women, the major caretakers, will express fear to avoid direct threat, rather than anger because directly expressed anger is more likely to result in impending danger to a baby’s life (Hampson et al., 2006). In conclusion, in line with the evolutionary perceptive, because the survival of children is contingent upon their mothers’ survival, while recognizing a possible threat, compared to men, women have more likely evolved to express fear, as an alarm in order to prevent direct aggression (Hampson et al., 2006; Taylor et al., 2000).

Even though some studies suggest that gender difference in expressed fear depends on different contexts (e.g., Campbell, 2006; LaFrance & Banaji, 1992), the majority of previous researchers have demonstrated that women have stronger experiential fear than men (Brody & Hall, 1993; Fischer, 1993; Gullone, 2000). Also, in contrast with men, women display stronger oral and nonverbal expression of fear (Campbell, 2006; Madden, Feldman Barrett, & Pietromonaco, 2000). When describing and viewing ”slasher” films, women reported intense fear while men reported intense anger (Nolan & Rya, 2000) At the same time, Thunberg and Dimberg (2000) found women were more facially expressive with higher increases in EMG activity on the corrugator supercilii than men when responding to “fear-relevant” pictures (e.g., angry faces and snakes). The investigation among nearly every culture and over time has found rates of fear occurrence and strength of fear is different between men and women (Brebner, 2003). According to aforementioned studies and hypotheses, we expected women to display stronger facial expressions and report more intense feeling of fear than men in response to fear-eliciting stimuli in the second trial.

Anger

Similar to fear, anger is an emotional reaction to aversive stimuli that normally occurs as a response to aggression (Campbell, 2006; Kring, 2000; Panksepp, 1998). When facing threatening behavior or actions, individuals usually have fear and anger as responses (Campbell, 2006). The expresser shows facial fear to the recipient as an acknowledgement sign of the threat occurrence, but the expresser exhibits facial anger as

a direct intimidation to the recipient (Adolphs, Russell, & Tranel, 1999; Whalen et al., 2001). Thus, it is expected fear and anger to have opposite functions: fear may reduce the likelihood of getting hurt, whereas anger may intensify the immediate danger (Marsh, Ambady, & Kleck, 2005). Previous findings that women fear more than men under anger-provoked conditions (Brody, Lovas, & Hay, 1995; Lerner, Gonzalez, Small, & Fischhoff, 2003) suggest that gender differences may be a factor in the facial expressions of both anger and fear.

Based on the evolutionary perspective in the context of gender disparity in negotiating statuses, men are more likely to dominate the power, status, fortune, physical quality, and intellect than women (Darwin, 1896), whereas women are more likely to be submissive and compliant, so less likely to express anger in order to avoid facing direct threat (Taylor et al., 2000). Instead, when confronting the potential aggressor, women are expected to show fear to avoid taking risks (Campbell, 2002), while men are expected to show anger to assert dominance. Boys are anticipated to grow up with dominant, independent, and competitive characters (Parsons, 1955). Maltz and Borker (1982) conducted a study of children's playing patterns and found girls were good at expressing and communicating their emotions in general, but they expressed limited anger; on the other hand, boys were adept in amplifying their anger, while restricting fear and sadness.

However, previous studies of gender differences in the expression of anger are not in agreement. Several research papers showed men and women are not different (e.g., Levenson, Ekman, & Friesen, 1990); a few studies found that, compared with men, women showed more expressions of anger (e.g., Friedman, Riggio, & Segall, 1980); and

a number of additional studies found that men are more adept at forming expressions of anger (e.g., Rotter & Rotter 1988). As regards the emotional experience of anger, some studies showed women reported higher self-ratings of most emotions than men (Gross & John, 1995; Kring, Kerr, Smith, & Neale, 1994), though pervious evidence for differences in intensity of experiential anger between men and women are not broadly discovered (King & Emmons, 1990). For example, several studies analyzing different samples among diverse nations found that there is no gender difference of self-reported anger (e.g., Archer & Mehdikhani, 2003; Deffenbacher et al., 1996; Kopper & Epperson, 1996). Also, in one study there was no gender difference in intensity rating of anger while watching films conveying anger (Kring & Gordon, 1998).

In summary, the evolutionary expectations indicate that women are likely to express less anger than men, but they are not different in the intensity of anger experienced as evidenced by previous studies. Based on aforementioned implications, we anticipated that men would show stronger facial expressions of anger, but would report a similar intensity of anger experience than women when reacting to the anger-eliciting stimuli used in the second trial.

Hypotheses statement

Facial expression is important in communicating emotion. Across cultures, people display similar facial expressions when conveying certain emotions. Some studies indicate that women appear to show stronger facial expressions of emotion than men (e.g., Barr & Kleck 1995; Halberstadt et al., 1988; Lang et al., 1993; Schwartz et al.,

1980). However, whether women and men differ in terms of the physiological intensity of their facial expressions, and in the reported experiential strength of their emotions, is still unclear.

A number of studies have used EMG as a measure of facial expression to examine gender differences in facial expressions of emotion. For example, women have a lager increase in EMG activity than men under emotional imagining conditions, (Dimberg & Lundquist, 1990; Schwartz et al., 1980), sound-listening conditions (Dimberg, 1990), and picture-viewing situations (Lang et al., 1993). Notably, women had higher correlations between facial EMG activities and self-rating of positive and negative emotions than men did (Grossman & Wood, 1993; Schwartz et al., 1980). The goal of the present experiment was to investigate gender differences in facial expressions and experiences of emotion in response to emotional stimuli as measured by facial EMG recordings on the zygomaticus major and corrugator supercilli muscles and by self-report assessment, respectively.

First trial

Our intention was to replicate the study conducted by Lang et al. (1993) and support our hypothesis that women would show more intense facial expressions and experiences of emotion than men when viewing photographs. Also, previous studies found participants increase EMG activity on the zygomaticus muscle during positive thoughts imagery, and the same increase occurred on the corrugator during negative thoughts imagery (Schwartz, Ahern, et al., 1979; Schwartz, Brown, et al., 1980; Schwartz, Fair, et al., 1976). Consistent with the predictions of the evolutionary roles

explanation of gender differences, the following hypotheses were developed to demonstrate that women were to show stronger facial expressions and experiential emotions than men in the first trial:

1. Both male and female participants would show higher EMG activity on the zygomaticus muscle than on the corrugator muscles when viewing pleasant photographs.
2. Participants were expected to show higher EMG activity on the corrugator muscle than on the zygomaticus muscle while viewing unpleasant photographs.
3. Women were hypothesized to show a larger increase in EMG activity on the zygomaticus muscle than men when viewing pleasant photographs.
4. Women would show a larger increase in EMG activity on the corrugator muscle than men when viewing unpleasant photographs.
5. Women were expected to report more extreme scores of experiential emotion than men across all emotions.

Second Trial

Though some studies have found that women showed more intense facial expressions than men (e.g., Halberstadt et al., 1988; Schwartz et al., 1980), it's still ambiguous whether gender differences in emotional facial expression are general or limited to particular emotions. The goal of the second trial was to examine whether women and men differ for the particular emotions of happiness, fear, and anger while

watching films provoking these emotions. Consistent with the evolutionary theoretical perspective and previous literatures on gender differences for these emotions, the following hypotheses were developed to demonstrate women would show stronger facial expression and experience of happiness, fear, but not of anger.

1. Considering the corrugator muscle activity is related to negative emotions, participants were expected to show higher EMG activity on the corrugator muscles than that on the zygomaticus muscles when watching films conveying anger and fear.
2. In view of the zygomaticus muscle and its link to positive emotions, participants were expected to have higher EMG activity on the zygomaticus muscles than on the corrugator muscles when watching films conveying happiness.
3. We hypothesized that men would show a stronger facial expression for anger and a larger increase in EMG activity on the corrugator muscles than women, but would show no differences in self-reported feelings of anger when watching film clips conveying anger.
4. Women were expected to show a stronger facial expression of happiness and a larger increase in EMG activity on the zygomaticus muscles than men when watching happy film clips.
5. Women were expected to show a stronger facial expression of fear and a larger increase in EMG activity on the corrugator muscle than men when watching fearful film clips.

6. Women were hypothesized to report more intense experiential emotions of happiness and fear than men.

METHOD

Participants

We recruited 100 students (50 men and 50 women) from a variety of psychology courses at Humboldt State University to participate in this study. Participants ranged from 18 to 58 years of age (M = 21.30, SD = 5.44). Age is not different between men and women, $t(98) = 0.715$, $p = .48$ (two-tailed), $d = 0.14$. Each participant indicated verbally that he/she was healthy and did not suffer from psychological, neurological, or visual disorders, and was compensated for participating in this study by receiving course credits in psychology offered by their instructors. The approved IRB consent form (APPDENIX A) was signed by each participant before experimental procedures were conducted.

Stimuli

First trial

The emotional stimuli consisted of 40 pleasant[1] and 40 unpleasant[2] color photographs selected from the *International Affective Picture System* (IAPS) (Lang, Bradley, & Cuthbert, 1999). IAPS rated the pleasant photographs as high pleasantness and calming, including scenes of romantic couples, happy babies, or beautiful scenery, and the unpleasant photographs were high unpleasantness and fear including scenes of violent death, bloody limbs, snakes, or angry human faces. Each 3 s photograph within 2 min pleasant and 2 min unpleasant categories was randomly ordered and projected to a 19-in computer monitor with a distance of 70 cm from the participant.

Second trial

Film clips were selected as being particularly emotional stimuli because Kring and Gordon (1998) stated that: (a) compared to the picture method which elicits short-term feelings, films are more likely to build up long-term feelings for specific emotions; (b) in contrast to experiencing historical emotional memory (e.g., imagery), film permits all participants to focus on responding to the specific emotion-eliciting stimuli; and (c) earlier experimental studies employing movies were effective at provoking specific emotions (e.g., Berenbaum & Rotter, 1992; Ekman, Davidson, & Friesen, 1990; Ekman, Friesen, et al., 1980; Gross & Levenson, 1993).

Gross and Levenson's (1995) 16 film clips were used successful to elicit a series of emotions including "amusement, anger, contentment, disgust, fear natural, sadness, and surprise" (p. 87). Six film clips from this set were chosen for this study to elicit happiness, anger, and fear with 2 different clips per emotion. The happiness film clips were taken from *When Harry Met Sally,* a scene depicting an orgasm conversation in a cafe, and a comedy show from *Robin Williams Live.* The anger film clips were from *My Bodyguard* and *Cry Freedom*, scenes depicting a bully and, the police killing and abusing protesters, respectively. One fear film clips was from *The Shining*, a scene where a boy played in a hallway, and the other was the basement chase view from *Silence of the Lambs.* The clips varied in duration, ranging from 82 to 478 s and 30 s of blackness, was interposed between each film clip as a distracter.

Measure

EMG response

We recorded EMG to measure facial expressions. A previous study indicated that the left side of face has stronger EMG activity than the right side of face in the procedure of emotional expression (Zhou & Hu, 2004), so in the present study we recorded facial EMG activity on the left corrugator and zygomaticus muscles. Two pairs of surface silver-silver chloride electric conductors were used to record facial EMG activity. A pair of electrodes was placed on the surface of corrugator supercilli muscle, and the other pair of electrodes was placed on the surface of zygomaticus major muscle. The locations of corrugator and zygomaticus muscles were decided by using Gray, Pick and Howden's anatomical description (1974). It is known that people brow when contracting corrugator muscle and people draw corners of their mouth up when contracting zygomaticus muscle (Gray et al., 1974).

A mild abrasive was used to clean the participant's skin where the EMG sensors were to be placed in order to increase the possibility of good contact. Then, a pair of electric conductors was placed 6 mm apart on each of the target muscles (i.e., corrugator and zygomaticus), followed by a ground electric conductor was placed on the left mastoid. Adhesive tape was used to keep the electric conductors stable and in place. The electric conductors were wired to two electronic amplifiers (Biopac System, EMG 100B, Santa Barbara, CA) to record zygomaticus and corrugator muscles activity. The amplifier had a sampling rate of 2048 samples per second with a passband of 0.1 Hz to 1000 Hz. The amplified electronic signals then were converted to digital signals by an

analog/digital converter (Biopac System, EMG 100B, Santa Barbara, CA). The digital signals were then saved on a Pentium desktop computer for off-line analysis.

Self-report of experiential emotion

First trial. The self-reported experience of emotion was measured using a 100 mm horizontal visual-analog scale of pleasantness (see APPDENIX B). The 100 mm horizontal line was used to indicate how much each participant felt a particular emotion during the two minutes of the viewing period. The Pleasantness scale ranged, left to right, from 0 to 100, with 100 (*Extremely Pleasant*) located at the right end of the scale, and 0 (*Extremely Unpleasant*) located at the left end of the scale. A score of 50 indicated a neutral emotional feeling. If the participant felt the emotional experience between rating 0 to 100, he/she would make a vertical line at a corresponding point of the scale.

Second trial. Depending on the emotion experienced, the scale of happiness (see APPENDIX C) ranged, left to right, from 0 to 100, with 100 (*extremely happy*) located at the right end of the scale and 0 (*extreme unhappy*) located at the left end of the scale. The scales of anger (see APPENDIX D) and fear (see APPENDIX E) were similar to the happiness questionnaire.

Procedures

The experiment's two trials were conducted in a laboratory located in the Psychology Department at Humboldt State University. After participants signed the consent form, each participant was guided to a sound and electricity-proof room and asked to sit in a chair. EMG sensors were then attached to the participant. The experimenters provided participants with instructions using an intercom system

periodically throughout the experiment. In order to avoid the gender of experimenters as a possible variable for the gender-specific results, each participant was guided randomly by two experimenters, one is female and the other is male, for two trials. First, each participant was asked to record EMG signals for a 2 min baseline. Experimenters monitored the EMG recording to make sure the participant was calm and showed no signs of extreme activity. The participant was asked to allow another baseline to be recorded if the EMG signals assessed during participant's activity period (e.g., coughing, laughing, sneezing) were suspected of impacting the ratio created from the data. After the baseline had been taken, the experimenter went into the electricity-proof room to ask the participant to make a mark on the pleasantness scale (APPDENIX B) to indicate their current emotional state. After the participant marked the emotional scale, she/he was asked to view a set of photographs that displayed pleasant scenery for 2 min while his/her EMG signals were recorded. Thereafter, the participant was asked to mark another pleasantness scale to indicate the emotional intensity felt while viewing these photographs. The participant rested for 2 min after marking the scale. Then, the participant repeated the same procedure, including 2 min baseline recording, marking of a pleasantness scale, 2 min EMG recording while viewing unpleasant photographs, and marking off on another emotional scale. Following this procedure, the participant was told the second trial of the experiment would begin.

During the second trial, the experimenter first instructed the participant to clear his/her mind of all thoughts and feelings as much as possible, and simply relax during the

5 min resting time. Next, the participant was asked to sit still for 2 min while a baseline EMG signal was recorded. Afterwards, the experimenter went into the room to request that participant mark the happiness scale (APPDENIX C). Then, the experimenter asked the participant to watch a pair of film clips conveying happiness for about 11 min while participant's EMG signals were recorded. Afterwards, the participant was asked to mark another happiness scale. When the participant finished marking the scale, he/she rested for 2 min.

The participant repeated the initial procedure, including 2 min baseline recording, marking off on an anger scale (APPDENIX D), a 10 min EMG signal recording during the 2 anger-eliciting film clips, marking off on another anger scale, and a 2 min rest to clear his/her mind. An identical procedure was conducted for 9 min fearful film clips using fear scales (APPDENIX E). In the end, the participant was debriefed and allowed to leave. The presentation orders of two photograph categories (pleasant and unpleasant) and the 3 paired film clips (happiness, anger, and fear) were randomized, meaning 1 of 12 different presentations was allocated to each participant randomly.

Data Analysis

EMG response

The saved EMG signals were analyzed by mathematical software (Biopac, Santa Barbara, CA) in the form of Fast Fourier Transformation (FFT). The EMG signals recorded were an epoch with digital time series with 120 s with 2048 samples per second. FFT converted the time epoch into a frequency epoch that started 1 Hz to 1024 Hz. The

spectral power μV^2 was calculated at each frequency Hz. The total spectral power from 20 Hz to 500 Hz was summed up for the epochs of baseline and photograph viewing or film watching periods separately. The spectral power was then square-rooted to reduce the variance of the signals. In order to minimize variations of individual difference, we calculated the ratio of the spectral power for the time epoch of photograph-viewing/film-watching to that of the 2 min baseline. For detailed description of EMG analysis, please see a recent research article (Zhou & Hu, 2004).

Self-report of experiential emotion

The ratings were calculated by measuring the length in millimeters from the left end of the scale to the mark. To minimize variations of individual difference, the differences of rating on emotional scales between photograph-viewing/film-watching and baseline periods were computed by taking the ratings of experiential emotions under viewing/watching periods minus the rating of experiential emotions under the baseline periods.

The means and standard deviations of differences in ratings for pleasantness, anger, happiness, and fear between the viewing/watching conditions and baseline periods were calculated for viewing and watching conditions according.

RESULTS

EMG Response of Facial Expression

First trial

The means and standard deviations for ratios of EMG activity recorded on the left corrugator and zygomaticus muscles between the periods of photograph-viewing, and baseline under the pleasant and unpleasant photograph viewing conditions are presented separately for men and women in Table 1.

A repeated measures analysis of variance (ANOVA) was conducted to evaluate whether there are gender differences in response to pleasant and unpleasant photographs on either the zygomaticus or corrugator muscle. The dependent variable was the ratio of EMG spectral power between periods of photograph-viewing and baseline in a 2 × 2 × 2 (Gender: men and women × Photographs: pleasant and unpleasant × EMG recording site: zygomaticus and corrugator) ANOVA including a between-subjects factor: Gender, and two within-subjects factors: Photograph and EMG recording site. The statistical results indicated that the main effect of gender was significant, F (1, 98) = 30.34, $p < .01$, $\eta^2 = .24$, but the main effect of photograph was not significant, F (1, 98) = 0.06, $p = .81$, $\eta^2 < .01$, and the main effect of EMG recording site was also not significant, F (1, 98) = 10.91, $p = .10$, $\eta^2 = .03$. There were no interactions between photograph and gender ($p = .11$, $\eta^2 = .03$) and between EMG recording site and gender ($p = .72$, $\eta^2 < .01$).

There was an interaction between photograph and EMG recording site, F (1, 98) = 76.14, $p < .01$, $\eta^2 = .44$. Further follow up comparisons using the paired samples t tests

Table 1

Means and Standard Deviations of the Ratio of EMG Activity on the Zygomaticus and Corrugator Muscles between Photograph-Viewing and Baseline Periods Recorded for Men (n = 50) and Women (n = 50).

EMG Activity	Gender	Photograph-Viewing Condition			
		Pleasant Photographs		Unpleasant Photographs	
		M	*SD*	*M*	*SD*
Corrugator	Men	1.45	1.17	1.69	2.82
	Women	1.24	0.95	4.52	3.25
	Total	1.34	1.07	3.10	2.79
Zygomaticus	Men	2.24	2.82	1.41	1.16
	Women	4.52	3.19	2.04	1.99
	Total	3.38	3.21	1.73	1.65

Note. Abbreviation: *M* = Mean and, *SD* = Standard Deviation.

showed that the ratio of EMG activity on the zygomaticus under the pleasant photograph was significantly higher than that on the zygomaticus under the unpleasant photograph condition, $t(99) = 6.11$, $p < .01$ (two-tailed), $d = 0.65$, and that on the corrugator under the pleasant photograph condition, $t(99) = 6.13$, $p < .01$ (two-tailed), $d = 0.85$. The comparisons also showed that the corrugator activity under the unpleasant photograph condition was significantly higher than the corrugator activity under the pleasant photograph condition, $t(99) = 5.65$, $p < .01$ (two-tailed), $d = 0.60$, and the zygomaticus activity under the unpleasant photograph condition, $t(99) = 5.23$, $p < .01$ (two-tailed), $d = 0.85$. There were no significant differences between the ratio of EMG activity on the zygomaticus while viewing pleasant photographs and that on the corrugator while viewing unpleasant photographs, $t(99) = 0.76$, $p = .45$ (two-tailed), $d = 0.09$, and between that on the zygomaticus while viewing unpleasant photographs and that on the corrugator while viewing pleasant photographs, $t(99)= 1.98$, $p = .05$ (two-tailed), $d = 0.27$.

The Gender × Photograph × EMG recording site interaction was significant, $F(1, 98) = 35.80$, $p < .01$, $\eta^2 = .27$. Figure 1 illustrates the gender differences in EMG activity on the corrugator and zygomaticus muscles while viewing pleasant and unpleasant photographs. Breaking down the interaction, further comparisons using separate independent samples *t* tests (see Figure 1) indicated that there was a significant difference of the EMG activity on the zygomaticus, $t(98) = 5.87$, $p < .01$ (two-tailed), $\eta^2 = .24$, and no significant difference of EMG activity on the corrugator, $t(98) = 0.97$, $p = .34$ (two-tailed), $\eta^2 < .01$, between men and women while viewing pleasant photographs. Under the unpleasant photographs condition, women had a larger EMG activity on corrugator

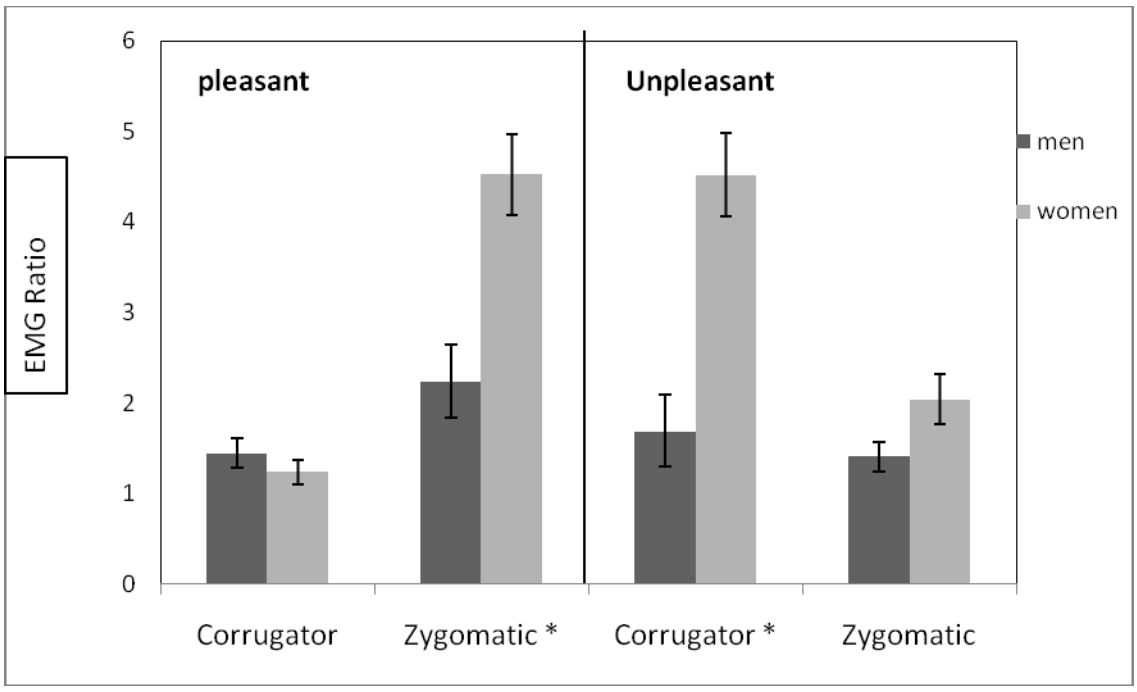

Figure 1. Means and standard errors of the ratio change for men (n = 50) and women (n = 50) in corrugator supercilii EMG activity, zygomaticus major EMG activity when viewing pleasant and unpleasant pictures.

Note. * $p < .05$.

than men, $t(98) = 3.77$, $p < .01$ (two-tailed), $\eta^2 = .03$, but no significant differences on the zygomaticus, $t(98) = 1.91$, $p = .06$ (two-tailed), $\eta^2 < .01$. These findings were consistent with my hypotheses that women would show stronger facial expressions than men.

Second Trial.

Table 2 presents the means and standard deviations for the ratio of EMG activity on the corrugator and zygomaticus between the periods of film-viewing and baseline under the angry, happy and fearful viewing conditions.

A repeated measures ANOVA was conducted to evaluate whether there were gender differences in response to angry, happy and fearful films on either zygomaticus or corrugator muscle. The dependent variable was the ratio of EMG spectral power between periods of film watching and baseline in a 2 × 3 × 2 (Gender: men and women × Film: angry, happy and fear × EMG recording site: zygomaticus and corrugator) ANOVA with a between subjects factor: Gender, and with two within-subjects factors: Film and EMG activity. The statistical results indicated that the main effect of Film was significant, $F(2, 97) = 15.73$, $p < .01$, $\eta^2 = .25$, the main effect of EMG recording site was significant, $F(1, 98) = 15.58$, $p < .01$, $\eta^2 = .13$, and the main effect of Gender was significant, $F(1, 98) = 7.98$, $p < .01$, $\eta^2 = .08$, but the Gender × EMG activity interaction ($p = .29$, $\eta^2 = .01$) was not significant.

The Film × EMG recording site interaction was significant, $F(2, 97) = 49.48$, $p < .01$, $\eta^2 = .51$. Further follow up with the paired samples t tests showed the ratio of EMG activity on the corrugator muscle under the angry film condition was significantly higher

Table 2

Means and Standard Deviations of the Ratio of EMG Activity on the Corrugator and Zygomaticus between Film-Watching and Baseline Periods Recorded for Men (n = 50) and Women (n = 50).

EMG Activity	Gender	Film-Watching Condition					
		Angry Film clips		Happy film clips		Fear Films clips	
		M	*SD*	*M*	*SD*	*M*	*SD*
Corrugator	Men	0.92	1.08	0.51	0.36	1.08	1.33
	Women	1.10	1.60	0.70	0.68	1.59	1.10
	Total	1.01	1.36	0.61	0.55	1.34	1.24
Zygomaticus	Men	0.67	0.72	1.86	1.89	0.82	0.74
	Women	0.63	0.74	3.22	2.85	0.99	0.87
	Total	0.65	0.73	2.54	2.50	0.90	0.81

Note. Abbreviation: *M* = Mean and *SD* = Standard Deviation.

than that on the zygomaticus under the angry film condition, $t(99) = 2.59$, $p = .01$ (two-tailed), $d = 0.33$, and that on the corrugator muscle under the happy film condition, $t(99) = 2.98$, $p < .01$ (two-tailed) $d = 0.36$. The zygomaticus activity under the happy film condition was significantly higher than the corrugator activity under the happy film condition, $t(99) = 8.49$, $p < .01$ (two-tailed), $d = 1.07$, under the fearful film condition, $t(99) = 6.59$, $p < .01$ (two-tailed), $d = 0.88$, and under the angry film condition, $t(99) = 7.48$, $p < .01$ (two-tailed), $d = 1.03$. The corrugator activity under fearful film condition was significantly higher than the zygomaticus activity under the fearful film condition, $t(99) = 3.42$, $p < .01$ (two-tailed), $d = 0.42$, higher than the corrugator activity under the happy film condition, $t(99) = 5.87$, $p < .01$ (two-tailed), $d = 0.76$, and higher than zygomaticus activity under angry film condition, $t(99) = 5.02$, $p < .01$ (two-tailed), $d = 0.68$.

The Gender × Film interaction was significant, $F(2, 97) = 3.55$, $p = .03$, $\eta^2 = .07$, and Gender × Film × EMG recording site interaction was also significant, $F(2, 97) = 5.82$, $p < .01$, $\eta^2 = .09$. Figure 2 illustrates the gender differences in EMG activity on the corrugator and zygomaticus muscles while watching angry, happy and fearful film clips. Further comparison using separate independent samples *t* tests (see Figure 2) indicated that women showed higher EMG activity on the corrugator muscle than men when watching fearful films, $t(98) = 2.09$, $p = .04$ (two-tailed), $\eta^2 = .04$, and higher EMG activity on the zygomaticus muscle than men while watching happy films, $t(98) = 2.81$, $p < .01$ (two-tailed), $\eta^2 = .08$; however, there was no difference in EMG activity on the corrugator muscle, $t(98) = 0.66$, $p = .51$ (two-tailed), $\eta^2 < .01$, and that on zygomaticus

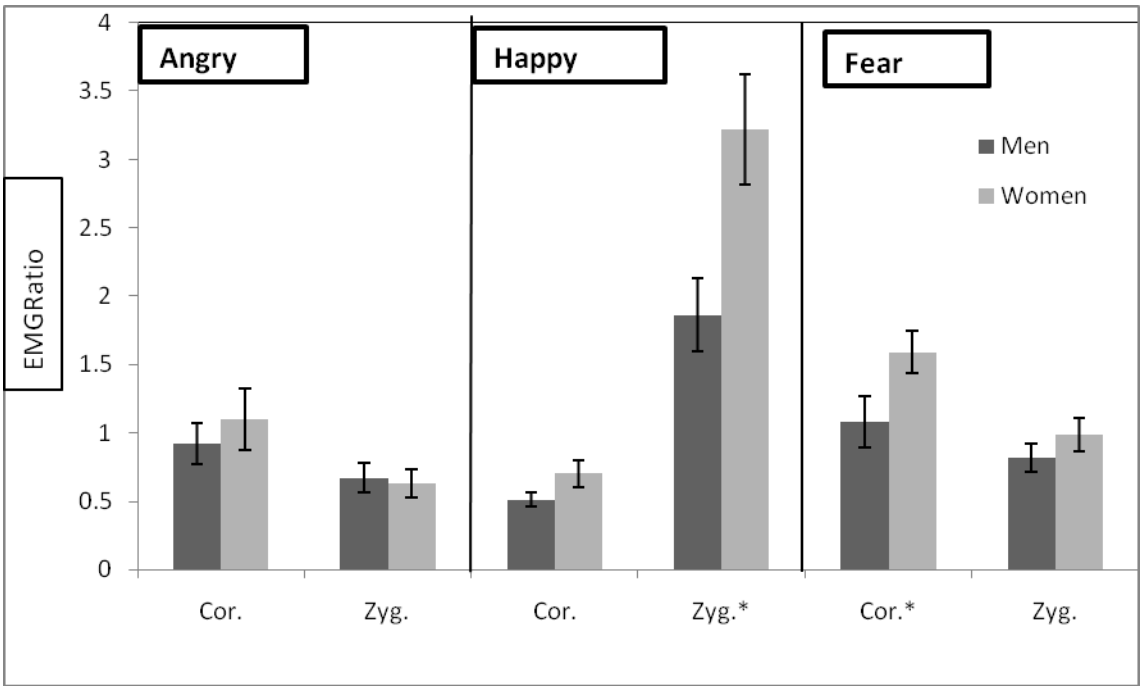

Figure 2: Means and standard errors of the ratio change for men (*n* = 50) and women (*n* = 50) in corrugator supercilii EMG activity, zygomaticus major EMG activity when watching the angry, happy and fearful films.

Note. Cor. = corrugator supercilii. Zyg. = zygomaticus major.

*$p < .05$.

muscle, $t(98) = 0.32$, $p = .75$ (two-tailed), $\eta^2 < .01$, between men and women while watching angry films.

Self-Report of Experiential Emotion

First Trial

The means and standard deviations for the differences in the ratings of pleasantness between the periods of photograph-viewing and baseline are presented separately for men and women in Table 3.

A repeated measures ANOVA was conducted to evaluate whether there are gender differences in experienced pleasantness when responding to photographs. The dependent variable is the differences in self-ratings of pleasantness in a 2 × 2 (Gender × Photographs: pleasant and unpleasant) ANOVA including a between-subjects factor: Gender and a within-subjects factor: Photograph. The statistical results indicated that the main effect of photograph was significant, $F(1, 98) = 410.42$, $p < .01$, $\eta^2 = .81$, and the main effect on gender was significant, $F(1, 98) = 5.27$, $p = .02$, $\eta^2 = .05$.

The Gender × Photograph interaction was significant, $F(1, 98) = 11.42$, $p = .01$, $\eta^2 = .10$. Further separate independent samples t tests (see Figure 3) indicated women ($M = -36.94$, $SD = 18.67$) reported a significant difference in the rating of pleasantness than men ($M = -23.34$, $SD = 17.84$) while viewing unpleasant photographs, $t(98) = 3.72$, $p < .01$ (two-tailed), $\eta^2 = .12$, but women ($M = 19.82$, $SD = 16.29$) and men ($M = 16.48$, $SD = 15.01$) reported no significantly difference in the rating of pleasantness while viewing pleasant photographs, $t(98) = 0.75$, $p = .46$ (two-tailed), $\eta^2 < .01$.

Table 3

Means and Standard Deviations of the Difference in the rating of Pleasantness between Photograph-Viewing and Baseline Periods Recorded for Men (n = 50) and Women (n = 50).

Gender	The Differences in the Rating of Pleasantness			
	Pleasant Photographs		Unpleasant Photographs*	
	M	*SD*	*M*	*SD*
Men	16.48	15.01	-23.34	17.85
Women	18.82	16.29	-36.94	18.67
Total	17.65	15.63	-30.14	19.41

Note. Abbreviation: *M* = Mean, and *SD* = Standard Deviation.

*****$p < .05$

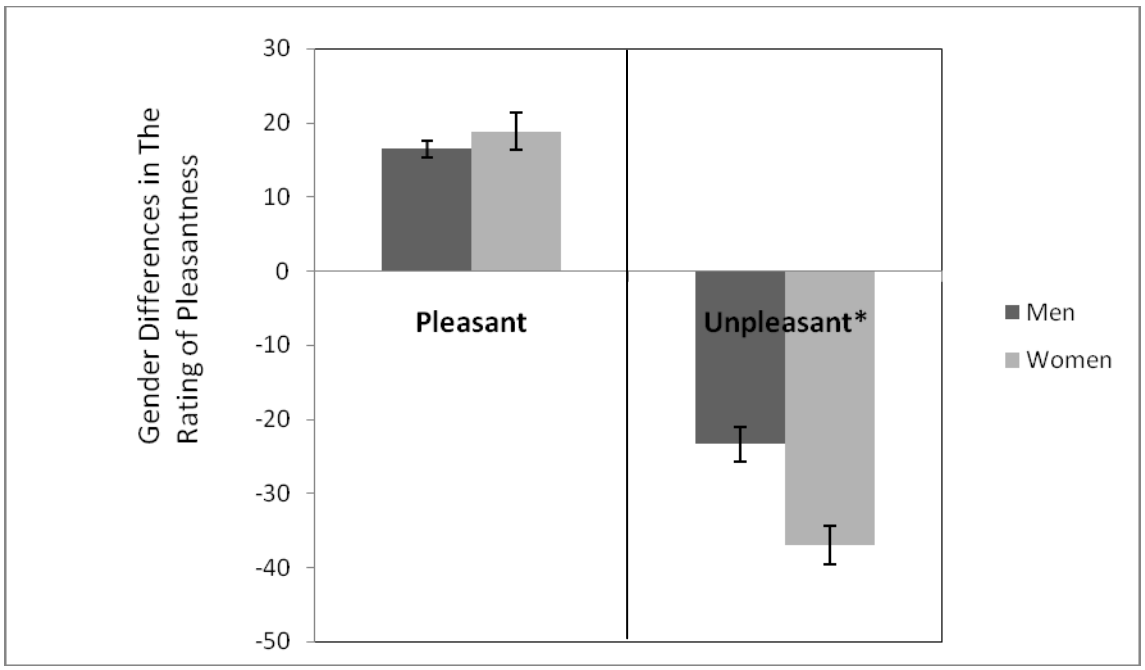

Figure 3. Means and standard errors of the difference for men (n = 50) and women (n = 50) in experiential pleasantness between photograph-viewing and baseline for pleasant and unpleasant photograph contents

Note. *p < .05.

Second trial.

Table 4 presents the means and standard deviations for the differences of ratings of experiential emotions between the periods of film watching and baseline under the angry, happy and fearful film-watching conditions.

A repeated measures ANOVA was conducted to evaluate whether there are gender differences in the ratings of experiential emotions when responding to film clips. The dependent variable is the difference of the ratings of feelings in a 2 × 3 (Gender × Film: angry, happy and fear) ANOVA with a between-subjects factor: Gender and a within-subjects factor: Film. The statistical results indicated that the main effect of film was not significant, F (2, 97) = 0.27, p = .77, $\eta^2 < .01$, and no significant main effect was found for gender either, F (1, 98) = 1.11, p = .29, $\eta^2 = .01$, but the Gender × Film interaction was significant, F (2, 97) = 2.82, p = .03, $\eta^2 = .07$. Further separate independent samples t tests (see Figure 4) indicated that women (M = 29.90, SD = 23.96) only reported a larger difference in the rating of fear than did men (M = 19.98, SD = 21.14) when watching fearful films, t(98) = 2.19, p = .03 (two-tailed), η^2 = .05. Women (M = 27.72, SD = 30.12) didn't report a significant difference in the rating of anger than did men (M = 24.90, SD = 19.58) while watching angry films, t(98) = 0.56, p = .58 (two-tailed), $\eta^2 < .01$, and also there was no difference in the ratings of happiness between women (M = 25.18, SD = 18.71) and men (M = 28.16, SD = 15.82) while watching happy films, t(98) = 0.86, p = .39 (two-tailed), $\eta^2 < .01$.

Table 4

Means and Standard Deviations of the Difference in the rating of Experiential Emotions (Anger, Happiness and Fear) between Film-watching and Baseline Periods Recorded for Men (n =50) and Women (n =50).

Gender	The Differences in the Rating of Experienced Emotions					
	Angry Film clips		Happy film clips		Fearful Films clips*	
	M	*SD*	*M*	*SD*	*M*	*SD*
Men	24.90	19.59	28.16	15.82	19.98	21.14
Women	27.72	30.12	25.18	18.71	29.90	23.96
Total	26.31	25.32	26.67	17.31	24.94	23.02

Note. Abbreviation: *M* = mean, and *SD* = Standard Deviation.

*****$p < .05$

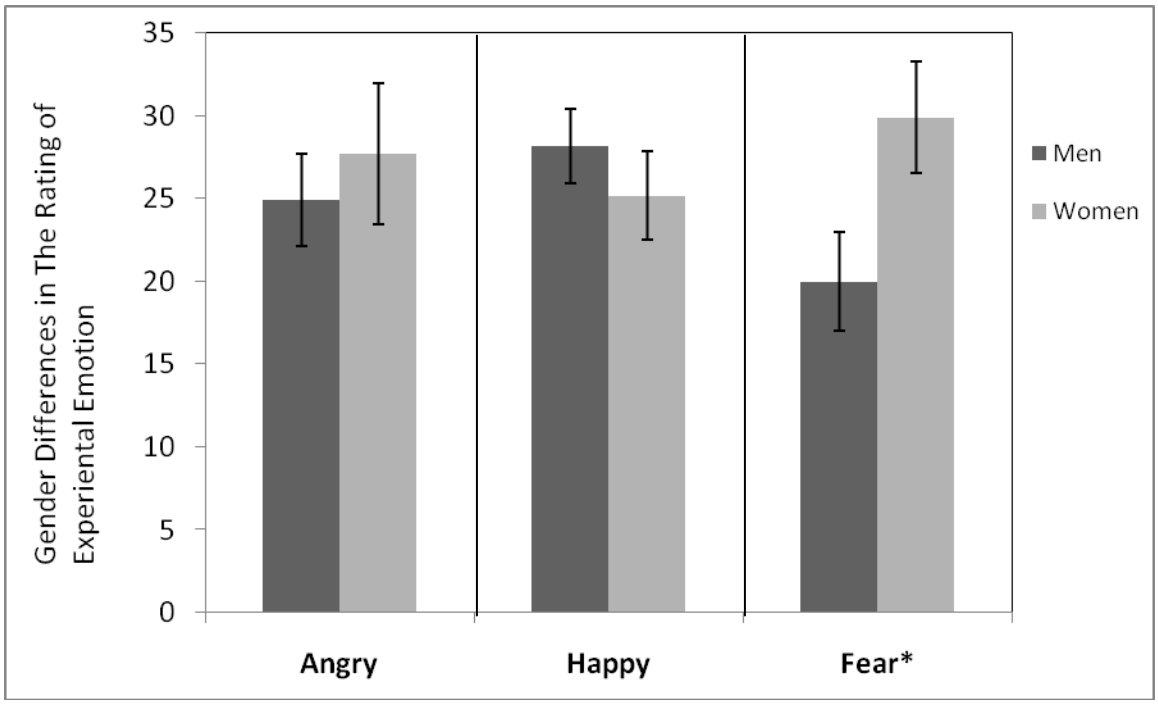

Figure 4. Means and standard errors of the difference for men (n = 50) and women (n = 50) in experiential emotion between film-watching and baseline for angry, happy and fearful film contents.

Note. *$p < .05$.

DISCUSSION

The Effect of Emotion on Facial EMG and Self-Ratings

The present study examined the patterns of facial EMG activity evoked by viewing emotion-eliciting photographs and films. The results were in support of our hypotheses. Participants showed higher EMG activity on the zygomaticus muscle than on the corrugator muscle when positive emotions were elicited. Conversely, participants showed higher EMG activity on the corrugator muscle than on the zygomaticus muscle when negative emotions were elicited.

In the first trial, participants demonstrated increased EMG activity on the zygomaticus major between the periods of viewing pleasant photographs and baseline as compared to the corrugator supercilii. On the other hand, participants demonstrated increased EMG activity on the corrugator between the periods of viewing unpleasant photographs and baseline (see Table 1). This pattern of the facial EMG results was consistent with earlier findings (Dimberg & Peterson, 2000; Larsen, Norris, & Cacioppo, 2003). In the second trial, the results were also in line with our expectations, indicating that watching films conveying a positive emotion, happiness in particular, provoked higher EMG activity on the zygomaticus than on the corrugator, while watching films conveying negative emotions, such as anger and fear, provoked higher EMG activity on the corrugator (See Table 2).

Regarding self-ratings, in the first trial self-reports of experiential emotion indicated that viewing pleasant photographs elicited an increase in feelings of pleasantness, and viewing unpleasant photographs elicited a decrease in feelings of pleasantness (See Table 3). This pattern of feelings was consistent with previous studies and demonstrated that positive and negative pictorial stimuli evoked the targeted emotions successfully (Lang et al., 1999; Larsen et al., 2003). In the second trial, the results of the experiential feelings (See Table 3) showed the participants experienced happiness, fear, and anger while watching films intended to convey these respective emotions, which confirmed that watching films clips can effectively evoke specific emotions (Gross & Levenson, 1995).

Combined the results of the facial EMGs and the self-ratings are in agreement with previous outcomes from studies that observed facial expression patterns and that demonstrated specific patterns of facial muscle movement are related to the range of emotions; tightening of the corrugator muscles is involved in wrinkling one's brows and is related to negative emotions, while tightening of the zygomaticus muscle is involved in creating a smile and is connected with positive emotions (e.g., Cacioppo et al., 1986; Smith, McHugo, & Lanzetta, 1986). Furthermore, this evidence supports Darwin's theory that emotional facial expressions are innate, and consequently, that facial expressions are associated with specific emotions (e.g., Ekman, 1997; Ekman & Friesen, 1971; Fridlund, 1991).

Gender Differences in Facial Expressions and Emotion

The hypothesis that women would exhibit stronger facial expressions than men while viewing pleasant and unpleasant photographs was supported in this study. Results clearly showed that compared to men, women exhibited significantly higher EMG activity on the zygomaticus major between the periods of viewing pleasant photographs and baseline, and higher EMG activity on the corrugator supercilii between the periods of viewing unpleasant photographs and baseline (see Figure 1). The facial EMG patterns were consistent with previous research, which reported that women tend to exhibit more extreme facial EMG activity than men under emotional imagining conditions (Dimberg & Lundquist, 1990; Schwartz et al., 1980), a sound-listening condition (Dimberg, 1990) and picture-viewing situations (Lang et al., 1993; Thunberg & Dimberg, 2000). Taken as a whole, these results suggest that women in general show stronger facial expressions than men, as hypothesized.

Our experimental data also indicated women felt significantly more intense feelings of unpleasantness than men while viewing unpleasant photographs. Conversely, women only showed a slight, but nonsignificant increase in pleasant feelings compared to men when viewing pleasant photographs (see Figure 3). This pattern of results was not accounted for by previous research, which reported that there was a gender difference on self-reporting of both negative and positive emotions, with women having stronger emotional experiences than men (e.g., Allen & Haccoun, 1976; Allen & Hamsher, 1974; Balswick & Avertt, 1977; Grossman & Wood, 1993; Larsen & Diener, 1987). The lack of

a gender difference in pleasant feelings may depend on different contents; perhaps women is previous studies only experienced more intense pleasant emotions when viewing pictures of infants (e.g., Grossman & Wood, 1993; Lang et al., 1993). Nevertheless, the results of the present study corresponded with Bradley, Codispoti, Sabatinelli, and Lang (2001) who found that men and women had similar responses to photographs that represented "life's joys and pleasures" (p. 316), except for men who felt more extreme enjoyment and arousal when exposed to "erotic" pictures (p. 316) and women who reported more intense feelings of unpleasantness and higher levels of physiological arousal than men while viewing all types of unpleasant photographs.

The experimental results support the evolutionary perspective which predicts that women are generally more sensitive to emotional experiences and consequently are more facially expressive than men due to different negotiating statuses and adaptation pressures (Buss, 1995). Consistent with parental investment theory, women have greater accountability during child rearing, and in order to rear children productively, women are more aware of and reactive to nonverbal signals because they are used to convey feelings or thoughts, especially in preverbal infants (Hall, 1984). Therefore, women are more likely to be responsive to others' feelings and emotional expressions, especially in the areas needed to improve child-bearing competence (Broverman et al., 1972).

Happiness

In support of the hypothesis that women would show stronger facial expressions than men when watching films conveying happiness, the second trial of the present study

showed that women exhibited more EMG activity on the zygomaticus major between the periods of happy films watching and baseline than men. Consistent with a number of previous investigations, the present study found that women exhibited stronger facial expression than men in response to positive emotional stimuli (Barr & Kleck 1995; Halberstadt et al., 1988; Kring & Gordon, 1998; Lang et al., 1993). It should mention that Kring and Gordon (1998) used a different methodological approach to measure the intensity of facial expressions in response to the same happy films that were used in this study. Their measure relied on the frequency of facial expressions as measured by the Facial Expression Coding System (FACES) (Kring & Sloan, 1991). Similar to the results of this study, their result showed that women exhibited stronger facial expressions than men in response to happy films, which suggests the FACES and EMG measure are both valid and interactive (e.g., Kring & Sloan, 2007).

These results are in agreement with the “attachment promotion hypothesis” which predicts that women would exhibit stronger facial expressions and better facial recognition of emotions than men because women respond more strongly to children’s emotional signals, especially facial cue because they are an important component of giving offspring the experience of a safe connection and the promise of well-being (Goldberg, 2000; Hall et al., 1986; Hampson et al., 2006). This hypothesis also predicts women will enhance expressions of positive emotions which won’t bring impending danger closer to the babies’ life (Hampson et al., 2006). In short, the fact that women showed stronger facial expressions than men can be elucidated by the hypothesis that

women's greater compliance and responsibility for caretaking are associated with expressions of happiness which help develop and keep good relation with their offspring.

Similar to the first trial of pleasant feelings, one reason for the lack of a gender difference in self-rating of happiness might be related to context (Grossman & Wood, 1993; Lang et al., 1993). Our result was consistent with the finding that there were no gender differences in the ratings of happiness when watching the same happy films (Kring & Gordon, 1998). There is no theoretical consensus that helps to illuminate this result, although we anticipated it could be explained by evolutionary theory perspectives. However, unexpectedly women did not report more intense feelings of happiness than men while watching films that were compatible with the study of Gross and John (1998), who found that men concealed their experiential emotions more than women, imply that there is gender difference in emotional expression but not emotional experience (Kring & Gordon, 1998).

Fear

Our hypothesis that women would show stronger facial expressions than men while watching films conveying fear was supported by this study, with results demonstrating that women exhibited more intense EMG activity on the corrugator supercilii between the periods of watching fearful films and baseline than men did. Consistent with previous studies, the present research showed that women displayed stronger facial expressions in response to fear stimuli than men (Bradley et al., 2001; Kring & Gordon, 1998; Thunberg & Dimberg, 2000). Similar to Kring and Gordon's study (1998), which reported that women showed more frequent facial expressions coded

for by FACES than men, our finding demonstrates that women show more intense facial expression as measured by EMG while watching the same fear-evoking films as men. Also, similar to the first trial of experiential unpleasant feelings, this result was consistent with Bradley et al. (2001) who found that women reported stronger feelings of fear while viewing all types of unpleasant pictures.

The increased intensity of women's expression and experience of fear provides support for the "fitness threat" hypotheses, which states that women's survival is a greater necessity when it comes to keeping children alive than is men's, explaining the gender differences in regard to fear (e.g., Hampson et al., 2006). The results indicate that women contribute greater effort to caretaking; as a result their offspring rely more on mothers than fathers, and have likely evolved a greater ability to recognize and express fear in order to evade direct aggression more effectively (Taylor et al., 2000).

Analyzing different forms of self-rating of emotions, Thunberg and Dimberg (2000) found no gender differences in the ratings of unpleasantness, taken on a scale from 0 (*not at all*) to 9 (*very much*), when viewing fear-irrelevant and fear-relevant stimuli. Kring and Gordon (1998) also found no gender differences in their reports of the experiential intensity of fear-disgust using a 4-point Likert scale ranging from 1 (*not at all) to* 4 (*very much so*) when watching fear-evoking films. Nevertheless, these results represented the combination of fear and disgust as representative of feelings of fear, so it is difficult to know whether the lack of a gender difference was due to the effects of fear or disgust. To provide clarification, a replication of both studies relying on the ratings

used in the present study would help determine whether men and women are different on self-reports of fear or disgust.

Anger

In contrast to fear, a response that serves in *avoiding* direct threats, anger is a normal emotional reaction that induces individuals to *confront* direct aggression (e.g., Campbell, 2006). Therefore, it was expected that fear and anger would have divergent effects on risk-taking, as fear may decrease the possibility of becoming injured, whereas anger may intensify the potential for injury through physical confrontation (March et al., 2005). The evolutionary perspective of gender differences in negotiating statuses predict that men are likely to control with power, status, wealth, physical quality, and intellect (Darwin, 1896), whereas women are likely to be obedient because successfully fulfilling the role of mother requires preventing direct aggression (Taylor et al., 2000). Consequently, we hypothesized that men would show stronger facial expressions of anger than women.

However, the present study did not support this hypothesis, instead finding that men and women were not different in EMG activity on the corrugator supercilii and zygomaticus major muscles between the periods of watching anger-evoking films and the baseline measure. It was interesting to note that women showed a slight, but nonsignificant increase in facial EMG activity on corrugator muscle compared to men when watching anger-evoking films. This is somewhat consistent with previous studies of emotional facial expressions, which found no significant gender differences, but did find

that women tended to show more intense expressions of anger compared to men, though the different was not significant (Kring, 2000; Kring & Gordon, 1998; Schwartz et al., 1980). Hence, we may not apply evolutionary perspectives to account for gender differences in facial expression of anger. Even though genders showed little difference in the intensity of anger expression, numerous studies show evidence for the diverse styles of anger expression between men and women (Campbell, 2006). On the one hand, men tend to face potential threat with direct angry expressions such as insults or physical attacks (Timmers, Fischer, & Manstead, 1998). Women, on the other hand, are more inclined to avoid direct front conflict, but more likely to cry (e.g., Averill, 1982; Timmers et al., 1998), or talk about their anger with individuals who are not taking part in a given conflict (Simon & Nath, 2004).

Consistent with a number of previous studies, our study found no difference between men and women in their self-report of the experiential intensity of anger. Though an earlier survey used a larger sample of women (n = 9067) who reported the feeling of anger somewhat more often and more intensely compared to men (Brebner, 2003), another study used an American sample and found no gender difference in the frequency of experiential anger (Simon & Nath, 2004). Our result is similar to that of Kring and Gordon (1998) who found no gender differences in experience during presentations of the same film clips used in this study to elicit anger. Therefore, the lack of gender differences in facial expression and experience of anger suggests that it is questionable to associate anger with gender difference in aggressive adaption (Bettencourt & Miller, 1996).

Analyzing facial expressions of EMG recordings from two muscle regions, Schwartz et al. (1980) using emotional imagery found that under the anger condition, women displayed more EMG activity on zygomaticus muscle than men, whereas men had a larger increase in EMG activity on messeter muscle which was not measured in the present study. It would be interesting to duplicate this study recording EMG activity on the messeter muscle region to determine whether facial expression of anger is different between men and women for that region.

Limitations and Future Research

There are four main limitations of the present study. First, even though our sample was varied in regard to age, our participants were obtained from a narrow geographic region (Humboldt County). Without ethnical and cultural information of the participants, it is difficult to come to a conclusion about similar patterns of facial expression activity used by other cultures (e.g., Ekman, 1993; Ekman & Friesen, 1971; Ekman, Friesen, et al., 1982). With facial expressions that permit EMG recording to be employed as reliable read-outs of emotion (Cacioppo, Martzke, et al., 1988; Cacioppo, Petty, et al., 1986; Dimberg, 1990; Vrana, 1993), it is also necessary to demonstrate that facial EMG is useful in various racial and cultural groups. Furthermore, the sample in the present study was primarily men and women attending college, similar to the previous studies of facial expression by EMG recording mentioned here with adult samples (e.g., Dimberg & Lundquist, 1990; Schwartz et al., 1980). Research on children is also valuable as gender differences in the facial expression of emotion may develop overtime

(Campbell, 2006). Even though we deem the pattern of EMG activity fond in this study would have validity in research for the reactions of children, this assumption must be empirically established.

Secondly, compared with Schwartz et al. (1980) who measured facial expressions by recording EMG activity on the corrugator, frontalis, depressor, and messeter muscles for the period of the imagery, as well as Bradley et al. (2001) who recorded activity on the corrugator, orbiculars oculi, and zygomaticus muscles during the pictures presentations, the present study investigated facial expression by EMG recording on the zygomaticus major and corrugator supercilii muscles only. As demonstrated by other researches, the intense activity on the corrugator muscle is associated with negative emotions, and the intense activity on the zygomaticus major muscle is related to positive emotions (e.g., Cacioppo et al., 1986; Smith et al., 1986). Schwartz et al. (1980) found men had greater EMG activity on messeter muscle than women when asked to imagine an anger producing condition, and Bradley et al. (2001) found women showed greater orbicularis oculi EMG activity than men while reflecting on both pleasant and unpleasant pictures. The EMG recording on more than two facial muscles is a reasonable goal for future research.

A further limitation to generalization is the results from the film-watching model. It is unknown if our sample felt intense emotions at the opening of the movie only, or whether they kept those emotional experiences invariably until the end, as a result "averaging over the entire 10 min probably led to underestimations of emotional effect" (Kreibig, Wilhelm, Roth, & Gross, 2007, p. 802). Mauss, Levenson, Wilhelm, McCarter,

and Gross (2005) have developed a method to explain growth and decline of a specific emotion. Considering that the lack of gender differences in happiness and anger for the period of watching films in this study may have been caused by this underestimation of emotion, employment of this new method may be warranted in future research. In addition, previous studies used different photograph contents to tag particular emotions (e.g., Bradley et al, 2001) and as a result may have been more effective in producing an emotional response since picture presentation is a short-term method to elicit emotions, so further research may consider use short-term (less than 10-minute) emotional stimuli as long as they can effectively provoke specific emotions (Kreibig et al., 2007). Moreover, because of their derivation from popular films, participants may have watched the film clips used in this study on a previous occasion, and this may have impacted the validity of this portion of the study. It would be interesting to replicate this study using different unfamiliar film clips.

Finally, in reaction to different aspects of emotions, our self-report results may have given an incomplete description of participants' emotional experience. Different labels for self-ratings may influence the judgment of participants' feeling rather than their true experiential emotions (Grossman & Wood, 1993; Shields, 1987). Though our data showed the emotion-eliciting films did tag the objective emotions (e.g., self-report of fear in response to the fear films), it was also possible that these films might induce other emotions simultaneously (e.g., fear-eliciting films are also probable to provoke aversion and surprise) (Kring & Gordon, 1998). In order to increase the validity and reliability of gender differences in the experiences of specific emotions, future research should

consider asking participants to report self-ratings of multiple emotional dimensions to confirm that emotional stimuli do convey the target emotions instead of other related emotions.

Conclusions

The present study provides support for the idea that gender differences in the facial expression of emotion derive from evolutionary forces. Parental investment theory suggests that parents contribute differing amounts of time and effort to invest in rearing their children (Trivers, 1971). Women contribute more precious reproductive abilities than men do, such as being pregnant, bearing heavy babies, and producing milk to feed their children. Women also invest more in children, resulting in an increased sensitivity to nonverbal signals, which are important for reading the feelings and thoughts of infants who are not yet able to talk (e.g., Babchuk et al., 1985; Hall, 1984). For this reason, women are expected to show stronger facial expressions and better facial recognition of emotions because mothers' have evolved to be highly responsive to children's emotional cues (facial cue in particular). It is essential to give their offspring the experience of safe relationship and the assurance of a healthy life (Goldberg, 2000; Hall et al., 1986). In support of this hypothesis, the first trial demonstrated that women in general had stronger facial expressions and stronger experiences of emotion than men, even though women did not show significantly higher ratings of pleasant feelings. Moreover, in the second trial, women generally showed more intense facial expressions than men, despite having similar emotional experiences while watching film clips. Compared with men, women showed especially stronger facial expression during the happiness and fear conditions,

but not during the anger condition. Women however, had more intense experiential fear than men, but did not differ in regard to anger or happiness.

The results of this study show that women had stronger facial expressions of happiness than men and support the evolutionary expectation that women have enhanced facially expressional responses to positive emotions to protect their children from fatality. However, the present study did not demonstrate the gender difference for the experience of positive emotions. It may depend on different contexts; for example women may feel more intense emotions when presented with photographs of infants (Grossman & Wood, 1993; Lang et al., 1993) and men may respond more strongly to erotic stimuli (Bradley et al., 2001).

That women had stronger reactions to negative emotions, especially fear, suggest that women's dominance of caretaking and greater contribution to offspring have led to the evolutionary motivation of their susceptibility to potential threat and expression of fear to avoid direct aggression (Taylor et al., 2000). However, the results were inconsistent with the hypothesis that women are obedient and that the mother's role of investing more in their offspring requires the prevention from direct aggression (e.g., anger), as there was no gender difference for facial expressions and experiential emotions on the anger condition. It is still uncertain whether the reason is that a gender difference for the facial expression and experience of anger does not exist, or whether the choice of film clips impacted the results. Future research should replicate this study by applying different stimuli to elicit anger.

Implications

Facial expressions communicate emotions. Across cultures, a list of elemental emotions has been identified, including: happiness, anger, fear, sadness, disgust, surprise, and contempt (Buck, 1984; Ekman, 1973; Izard, 1977). The present experimental design investigated only three of these emotions. Future studies should continue to explore the full variety of facial expressions and the emotions they correspond to (e.g., sad, disgust) in relation to gender differences. Also, further multi-cultural research for gender differences in facial expressions of emotions would aid an understanding of the influence of evolutionary pressures in shaping genders' response to emotional signals.

The implications of the present research provided empirical support for the evolutionary interpretation of gender differences in emotions. On the whole, women are more facially expressive than men, hence when reviewing previous studies or planning future research for emotional facial expressions, researchers should be careful to take account for whether the sample keeps the balance of gender, since gender is a crucial factor that can cause different emotional outcomes (Schwartz et al., 1980). If the sample size is limited, Schwartz et al. (1980) suggest that women are preferred because the intensity of their facial expressions is easier to observe.

Facial expression can also be used to identify the efficiency and effectiveness of various therapies. For example, during acceptance and commitment therapy (Blackledge & Hayes, 2001), facial expression could be recorded using EMG as an unbiased index of the patient's emotional pattern during long exposure to phobic stimuli. For the first

exposure to phobic stimuli, patients would be anticipated to exhibit stronger and lengthier facial expressions, while during treatment patients would be expected to exhibit weaker and shorter facial expressions providing an indication that patients were successfully accustomed to the phobic stimuli (Foa & Rothbaum, 1998; Kring & Sloan, 2007). However, when using facial EMG data during exposure therapy, the gender disparities in the intensity of the facial expression of emotion observed in this study should be taken into account, especially when interpreting the effectiveness of treatment for male and female patients.

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APPENDIX A
CONSENT TO ACT AS A RESEARCH PARTICIPANT

Department of Psychology, Humboldt State University

Title of proposal:

"Gender Differences in Facial Expressions of Emotions"

I certify that I am over the age of 18. I hereby agree to participate in a study conducted by (Yumi) Hsin-Yu Huang (graduate student in Psychology) and her research assistants.

The procedure involved in this study requires 60 minutes of participation for one session. The experiment will be conducted in a private suite of a laboratory in the Department of Psychology.

I have read and understand the following description of this study: "Gender Differences in Facial Expressions of Emotions. " The purpose of this study is to investigate effects of facial expression on facial EMG activities and experienced emotion on self-report measures when reflecting emotion stimuli. The results of these may help us to find physiological indicators of emotions."

I understand that the procedure described involves the following risks: 1) the participants who are allergic to the electrode gel will develop slightly red skin locally and feel itchy for a couple of hours. The chance of this occurring is less than 1 in 100; 2) participants may have a short moment of emotion change.

In the case that I might develop severe subjective discomfort during the experiment the experimenters will terminate my participation in the experiment immediately.

This information was explained to me by _____ and I understand that he/she will answer any questions I may have concerning the procedures used in this study at any time.

I understand that my participation in this study is voluntary and that I may decline to enter this study and may withdraw from it at any time without jeopardy. I understand that the investigator may terminate my participation in the study at any time. I understand that if I have any questions, problems, or concerns about this study I can contact Yumi Huang by calling her cell phone 626-465-6190 or email hh33@humboldt.edu. I understand that if I have any questions regarding my rights as a human participant in this study I may contact the Committee for Protection of Human Subjects at Humboldt State University at 826-3949.

I understand that I will not receive any financial compensation for the completion of this study.

_____ _____

Participant's Signature Date

APPENDIX B
PLEASANTNESS SCALE

Age_____ Gender M F Date_____

Please rank how intense your true emotional feelings were during the 2 minutes period. If you did not truly feel the emotion in any way please mark “50”. If you felt extremely unpleasant, please mark “0”. If you felt extremely pleasant, please mark “100”. If your emotion was between 0 to50 or between 50 to100, please mark it at an appropriate spot on the line.

Extremely Unpleasant — Extremely Pleasant

0 50 100

APPENDIX C
HAPPINESS SCALE

Age_____ Gender M F Date_____

Please rank how intense your true emotional feelings were during the film period. If you did not truly feel the emotion in any way please mark “50”. If you did feel extremely unhappy, please mark “0”. If you felt extremely happy, please mark “100”. If your emotion was between 0 to50 or between 50 to100, please mark it at an appropriate spot on the line.

Extremely Unhappy — Extremely happy

0 50 100

APPENDIX D
ANGER SCALE

Age_____ Gender M F Date_____

Please rank how intense your true emotional feelings were during the film period. If you did not truly feel the emotion in any way please mark “50”. If you did feel extremely calm, please mark “0”. If you felt extremely angry, please mark “100”. If your emotion was between 0 to50 or between 50 to100, please mark it at an appropriate spot on the line.

Extremely Calm — Extremely Angry

0 50 100

APPENDIX E
FEAR SCALE

Age_____ Gender M F Date_____

Please rank how intense your true emotional feelings were during the film period. If you did not truly feel the emotion in any way please mark “50”. If felt extremely fearless, please mark “0”. If you felt extremely scared, please mark “100”. If your emotion was between 0 to50 or between 50 to100, please mark it at an appropriate spot on the line.

Extremely Fearless		Extremely Fearful
0	50	100

FOOTNOTES

[1] The code number of 40 selected pleasant photographs rated by the IAPS as highly pleasant and calming valance were 1234, 1440, 1460, 1463, 1601,1710, 1750, 1811, 1812, 1999, 2000, 2040, 2050, 2057, 2070, 2091, 2165, 2222, 2311, 2340, 2345, 2352, 2360, 2370, 2501, 2530, 2655, 2660, 3456, 4603, 5621, 5831, 5910, 7200, 7350, 7470, 7502, 8190, 8030, 8032.

[2] The code number of 40 selected pleasant photographs rated by the IAPS as highly unpleasant and fearful valence were 237, 1022, 1050, 1111, 1300, 1930, 1945, 2053, 2352, 3000, 3010, 3015, 3030, 3053, 3062, 3064, 3080, 3100, 3102, 3110, 3130, 3140, 3150, 3170, 3261, 3266, 3400, 6313, 7380, 8480, 9040, 9042, 9300, 9405, 9410, 9420, 9490, 9561, 9584, 9921.