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The Effects of Face-to-Face and Online Social Stress on Emotion Identification

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Abstract

The present study examined whether the Trier Social Stress Test (TSST) could be replicated in online, text-based communication, and whether both online and in-person social stress impacted emotion identification. Participants were college students (n = 58) who experienced stress elicitation either face-to-face (TSST) or online (e-Trier). They then identified angry, fearful, happy, and ambiguous angry-fearful facial expressions. The effectiveness of the TSST was replicated, while the e-Trier was only successful in eliciting stress at the mid-point of the task. In the less stressful conditions (e-Trier and control) men identified ambiguous expressions as significantly more angry than women, while this gender difference was not evident in the stressful condition (TSST). Men were also more likely to misidentify true fearful faces as angry. These results indicate that men tend towards over-interpreting angry expressions, but this gender difference is diminished with experienced stress.

Keywords: stress, emotion identification, Trier Social Stress Test, gender differences, online communication

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Communication via the Internet and cellphones has changed the social landscape over the past two decades in many ways that have yet to be fully explored or understood. Text–based communication is ubiquitous in Western countries; one study found that college students received an average of 37 texts per day and initiated 16 texts per day (Clayson & Haley, 2013). Another found that 83% of people 18-29 years old used some form of social media daily (Duggan & Brenner, 2013). The way that people are conversing and interacting socially has become rooted in the digital world. Preliminary evidence indicates that social media and text communications do have an impact on the way an individual feels and functions in the "real-world." After people shared negative personal events on social media, their negative affect increased; after they shared positive personal events on social media, their positive affect increased (Choi & Toma, 2014). In another study, 85% of adolescents who have experienced online bullying also experienced bullying in school (Juvonen & Gross, 2008). These investigations suggest that emotional experiences in social media mirror and impact emotional experiences in the "real-world"; these two realms of socialization and communication are inextricably connected. The current study compared the strength of an in-person, or face-to-face, social stress elicitation compared with an online social stress elicitation.

In-person elicitations of social stress have been explored in depth. The Trier Social Stress Test (TSST) was first published in 1993, before online communications became so widespread. The TSST elicits social stress by requiring participants to deliver a free speech and perform mental arithmetic in front of an audience that does not provide any positive feedback (Kirschbaum, Pirke, & Hellhammer, 1993). Numerous studies have explored the broad effects of the social stress elicited by the TSST and have found that, under social stress, people experienced higher levels of negative affect, increased emotion-oriented and avoidance-oriented coping, and lower mean levels of psychological resources (Zeidner & Ben-Zur, 2014).

Because so much social interaction in the twenty-first century exists online with text-

based communication, it is necessary to understand how social stress and anxiety functions in online environments. There is a noticeable gap in research regarding online elicitations of social stress, whether they are effective in eliciting stress, and what their subsequent effects are. A handful of studies replicated the TSST in a virtual reality environment, by utilizing a virtual audience projected on a 3-D screen or 3-D goggles (Montero-López et al., 2015; Ruiz et al., 2010). These virtual versions of the TSST have been found to be just as effective as the original TSST in eliciting social stress, both physiologically and subjectively. However, no study to date has taken the adaptation of the TSST fully online to examine whether the TSST could be successfully adapted to text-based communications, such as instant messaging, that are experienced without seeing an audience.

An online, text-based version of the TSST could solve some of the limitations that arise in the original TSST, such as unreliable audience reactions, and in the virtual reality versions of the TSST, such as expensive technological equipment (Montero-López et al., 2015). An effective online, text-based version of the TSST would standardize the TSST at an affordable cost, thus allowing for broader exploration of the phenomenon of social stress. This is the first study to compare face-to-face and online versions of the TSST.

Among the numerous studies examining the effects of the TSST-elicited stress, a subset has specifically looked at how social stress impacts the processing of expressions of emotion. Chen, Schmitze, Domes, Tuschen-Caffier, and Heinrichs (2014) found that acute social stress, elicited by the TSST, changes children's processing of facial expressions of emotion in others. The researchers induced stress in a group of nine- and ten-year-old boys using a children's version of the TSST. They then gave the boys pictures of people making ambiguous angry-fearful facial expressions and asked them to categorize the faces as either angry or fearful. The boys who had undergone the TSST condition were significantly more likely to categorize the faces as fearful compared with the boys who had not undergone the TSST (Chen et al., 2014). The researchers theorized that the boys categorized the ambiguous faces as fearful because they were unable to separate others' experiences from their own, due to their developmental stage. The participants felt nervous and stressed, and so they thought that the people conveying ambiguous angry-fearful faces were as well (Chen et al., 2014).

The population of Chen et al.'s (2014) study was very specific, focusing on only boys, not girls, and children, rather than adults. Another study explored the emotion detection effects of social stress with adult participants of both genders. The researchers induced anticipatory social stress in the participants, simply by telling them they would have to make a speech, and then asked them to look at different facial expressions, such as true angry, happy, and sad faces (Wieser, Pauli, Reichert, & Muhlberger, 2009). Wieser et al. (2009) discovered that the participants who anticipated social stress had enhanced perceptual processing of and motivated attention to angry faces relative to happy and neutral faces. The researchers theorized that this was because anxiety triggers the selective processing of threatening stimuli, in this case, angry faces (Wieser et al., 2009). Clearly social stress influences social interaction, particularly emotion perception and identification. To our knowledge, no study has synthesized Chen et al.'s (2014) and Wieser et al.'s (2009) research to look at how an *adult* population of *both* genders processes ambiguously angry-fearful faces *after* they have experienced social

stress. This work would inform understanding how the internal experience of social stress impacts external social interactions, including the processing of emotional expressions.

The present study first examined whether an online, text-based version of the TSST (e-Trier) was as successful as the original TSST in eliciting stress. It was hypothesized that the e-Trier would induce less stress than the face-to-face TSST condition, but significantly more stress than a control condition. While the virtual reality version of the TSST elicited the same amount of social stress as the original TSST (Ruiz et al., 2010), the e-Trier condition did not include any facial reactions from an audience or evaluator. However, this does not negate the fact that the e-Trier, as a social interaction with ambiguous feedback, had the potential to elicit significantly more social stress than a benign control condition.

Following the elicitation of stress, the impact of social stress on the perception of emotion, particularly the emotions of anger and fear, was examined. It was hypothesized that participants in both the original TSST and the e-Trier would identify ambiguous angry-fearful faces as more angry. While the children in Chen et al. (2014) identified ambiguous angry-fearful faces as more fearful than angry, we expected that the young adult sample would behave more similarly to other adults of Wieser et al. (2009).

In sum, this research pursues two aims: to test the boundaries of the TSST by implementing it online and to test the effects of face-to-face and virtual social stress on emotion identification. Understanding how social stress manifests in modern online contexts and how that manifestation may impact emotional cues is especially important as society moves towards an ever more digital age.

Method

Participants

Participants were 58 college students (65.5% women; 67.2% Caucasian) with an average age of 19.9 years (SD=1.31). Participants were entered into a raffle for a $30 Wal-Mart gift-card as compensation. They were recruited through email announcements sent to the college student body and through personal requests for participation.

Procedure

All participants were run individually. Before starting the study, the participants were told that the study was about the "emotional content of words in a speech." The participant then signed a copy of the IRB-approved consent form and watched a neutral calming video of Old Orchard Beach, Maine, to relax the participant and counter any emotional spillover as they began the study.

Next, the experimenter set the participant up on the computer program Qualtrics, which was used to collect all data. The participant first provided demographic information (gender, age, race/ethnicity, and class year) and then completed a baseline subjective stress self-evaluation.

For the stress elicitation, the participant was randomly assigned (following a list generated from randomizer.org) to one of three conditions: *TSST, e-Trier*, or *control*. The TSST condition was similar to the original Trier Social Stress Test, but the experimenter served as the neutral audience (Kirschbaum, Pirke, & Hellhammer, 1993). The e-Trier condition was a version of the TSST, but adapted for online, text-based communications. It took place on Google-Talk, an instant messaging service on Gmail that provides text communication, and was operated by a second experimenter from a remote location. The control condition

replicated the tasks given in both the TSST and the e-Trier, but without the social evaluation component.

The first part of the stress elicitation involved arithmetic. Participants in the TSST condition were first asked to count down from 1,023 by intervals of 13 as quickly and accurately as possible. If the participant made an error or did not respond for 10 seconds, they were asked to go back to 1,023 and start again. After three minutes, the experimenter stopped the participant. Participants in the e-Trier condition were asked over Google-Talk to perform the same task, but they typed the numbers into Google-Talk. Participants in the control condition performed a page of simple math problems for three minutes. All participants then filled out another stress evaluation.

The next part of the stress elicitation involved giving a speech. Participants in the TSST condition were told that they would have to give a five-minute free speech as if they were interviewing for their dream job and had to describe how they were the best candidate. They were given two minutes to prepare notes but could not use them during the speech. The participant then verbally gave their speech to the experimenter, while being audio-recorded, which they were told would be saved for later coding. The experimenter maintained a neutral facial expression and gave no verbal or non-verbal feedback. If the participant stopped speaking for twenty seconds, the experimenter said, "You still have time remaining, please continue." After five-minutes the experimenter stopped the participant. The participants in the e-Trier condition were given the same prompt and thinking period, but typed their response, sentence by sentence, into Google-Talk, which they were told would be saved for later coding. The experimenter on the Google-Talk responded neutrally, with ellipses, and said, "You still have time remaining, please continue," if the participant stopped typing. Those in the control condition wrote about how they were the best candidate for their dream job in a blank Word document for five minutes, which they were told would be saved for later coding.

Participants in all conditions subsequently completed a third stress evaluation. Then they completed the emotion identification task, the Brief Fear of Negative Evaluation Scale, and the State-Trait Anxiety Inventory-Trait.

Finally, in order to counteract any residual stress, the participants watched an uplifting video to induce positive affect and hope. The participants were debriefed as to the purpose of the study and the reason for the stressful conditions. The experimenter was particularly positive towards the participant during the debriefing. Voice recordings, Google-Talk histories, and the Word files were visibly deleted as the study session was concluded.

Measures

Stress Self-Evaluation. The stress self-evaluation was a one-item self-report measure, created for the study, assessing current stress level. The item was rated using a 100-point scale ranging from "not at all" to "extremely."

State Trait Anxiety Inventory for Adults – Trait (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI-T is a 20-item self-report questionnaire that evaluates disposition to respond with anxiety to situations perceived as threatening (trait anxiety). Items are rated on a scale from 1 (almost never) to 4 (almost always). The STAI-T is among the most widely used measures of general anxiety and has demonstrated good reliability and validity (Okun, Stein, Bauman, & Silver, 1996; Sanal & Gorsey, 2014).

Brief Fear of Negative Evaluation Scale (BFNE; Leary, 1983). The BFNE is a 12-item self-report measure used to assess fears of negative evaluation associated with social anxiety. Items are rated on a scale from 1 (not at all characteristic of me) to 5 (extremely characteristic of me). The BFNE has demonstrated strong reliability and convergent validity (Rodebaugh et al., 2004; Leary, 1983).

Materials

Emotional Expressions (Langner et al., 2010). The set of faces shown on the computer screen during the emotion identification task were drawn from the Radboud Faces Database (Langner et al., 2010). These faces displayed fearful, angry, or happy expressions, as well as ambiguous expressions, a combination of fearful and angry faces morphed together using FantaMorph software. The set contained 32 photos of 8 individuals, half women and half men; participants viewed all 32 photos. They were given up to 5 seconds to identify the emotion expressed through multiple choice selection (happiness, fear, anger). The order of presentation was randomized within the computer program Qualtrics.

Results

Emotional Effects of Condition

There were no differences between conditions in trait anxiety, fear of negative evaluation, or baseline stress, as shown in Table 1, suggesting that randomization was successful.

The first hypothesis predicted that the TSST condition would be significantly more stressful than the e-Trier condition and that the e-Trier condition would be significantly more stressful than the control condition. In order to determine whether there was an effect of stress elicitation components on stress level, a mixed ANOVA was conducted with time as the within-subject factor and condition as the between-subject factor. The repeated measures ANOVA revealed a main effect of condition, $F(2, 55) = 5.91$, $p = .005$, $\eta_p^2 = .177$, a main effect of time, $F(2, 110) = 2.99$, $p = .054$, $\eta_p^2 = .052$, and a Condition x Time interaction, $F(4, 110) = 6.32$, $p < .001$, $\eta_p^2 = .187$.

Follow-up one-way ANOVAs were conducted at the mid-point of the elicitation (following the arithmetic component) and at the end of the elicitation (following the speech component). As shown in Figure 1, there was a significant difference between stress levels at the mid-point of the elicitation, $F(2, 57) = 3.99$, $p = 0.024$, $\eta_p^2 = .127$. Participants in the e-Trier condition ($M = 52.22$, $SD = 23.67$) were significantly more stressed than participants in the control condition, ($M = 29.89$, $SD = 21.89$), $p = 0.021$. Participants in the TSST condition ($M = 44.81$, $SD = 27.54$) were not significantly more stressed than participants in the control condition, $p = 0.144$.

Stress levels were also significantly different at the end of the elicitation, $F(2, 57) = 14.16$, $p < 0.001$, $\eta_p^2 = .340$. Participants in the TSST condition ($M = 66.90$, $SD = 19.29$) were significantly more stressed than the participants in the other conditions, ps < 0.001. E-Trier condition participants ($M = 37.50$, $SD = 21.63$) were not more stressed than control participants, ($M = 35.58$, $SD = 21.99$), $p = 0.958$. The results show that stress was dependent not only on condition, but also on the stress elicitation component. The e-Trier condition was significantly more stressful at midpoint than the control condition, while the TSST condition gained impact and was more stressful than both the e-Trier and control conditions by the end of the elicitation.

Trait anxiety and fear of negative evaluation were examined as moderators of

stress response and were not significant, p = 0.709 and p = 0.276, respectively.

Emotion Identification

A 3x2 ANOVA was conducted to determine whether emotion identification of angry-fearful morphed faces was affected by stress condition and gender. Contrary to the second hypothesis, there were no significant differences in emotion identification between conditions, $F(2, 52) = .579$, $p = 0.564$, $\eta_p^2 = .022$. However, there was a main effect for gender with men identifying more anger than women, $F(1, 52) = 9.25$, $p = 0.004$, $\eta_p^2 = .151$. In addition, there was a significant interaction between gender and condition, $F(2, 52) = 3.95$, $p = 0.025$, $\eta_p^2 = .132$ (Figure 2). In the e-Trier condition, men identified a higher proportion of the angry-fearful morphed faces as angry (M = 0.50) than women (M = 0.21). In the control condition, men also identified a higher proportion of morphed angry-fearful faces as angry (M = 0.45) than women (M = 0.31). Yet, when stressed in the TSST condition, men (M = 0.31) and women (M = 0.34) identified anger at equal rates.

Post-hoc analyses examined whether there were gender differences in ability to identify true, un-morphed angry and fearful faces. Independent sample t-tests indicated no difference between genders in ability to identify angry faces, $t(56) = .305$, $p = 0.761$, d = 0.09; however, as shown in Figure 3, women were significantly more likely to correctly identify fearful faces, $t(27.88)$ = 2.24, p = 0.033, d = 0.66. All participants identified true happy faces correctly, so there were no differences to analyze.

Discussion

This study is the first to pilot a new, text-based version of the Trier Social Stress Test, called the e-Trier, and to compare it to the original TSST in effectively eliciting social stress. The study also investigated how face-to-face versus online social stress impacted the perception of ambiguous emotional expressions.

The e-Trier

It was hypothesized that the original TSST would remain the most effective method in eliciting social stress, but that the e-Trier condition would be significantly more effective in eliciting social stress than a control condition. In line with this hypothesis, the original TSST condition elicited significantly higher stress by the end of the stress elicitation. However, at the mid-point of the stress elicitation, after the arithmetic component, the e-Trier condition elicited significantly higher stress than the control condition, while the original TSST was not significantly more or less stressful than either the e-Trier or the control condition.

The general effectiveness of the TSST replicates a multitude of previous research (Kudielka, Hellhammer, & Kirschbaum, 2007). Most of the research done on the TSST, however, only measures stress levels twice – once at baseline and once after the stress elicitation. The present findings emphasize the importance of the ordering of the components. This study found that the speech portion of the TSST elicited the most stress, in comparison to the arithmetic portion, as have other researchers (Hellhammer & Schubert, 2012). Of note, the self-reported stress of participants following the TSST arithmetic section was not greater than the self-reported stress of control participants. In the traditional TSST, arithmetic follows the speech portion and participants report high stress post-TSST. The discrepancy in our findings could have been because the arithmetic portion was three minutes in length rather than the traditional five. However, it also may be that the stress of the speech portion in the traditional TSST

carries over into the arithmetic portion but arithmetic offers less additive stress.

Conversely, the e-Trier was successful in eliciting stress, but only after the arithmetic portion. After the speech portion of the e-Trier, participants reported their stress levels as low, close to those in the control condition. This may have occurred because the facial feedback from the experimenter was integral to participants' stress responses in the speech portion. Previous research has shown that, "emotional expressions and gestures are visibly imitated by observers and that this imitation is accompanied by self-reports of the associated emotional state" (Niedenthal, 2007, p. 1004). The emotional experience of individuals is impacted by the facial expressions of others. Therefore, the participants in the traditional TSST could have embodied the non-positive emotional reaction of the experimenters. TSST participants had heightened awareness of less than positive feedback while this remained more ambiguous to e-Trier participants.

Another explanation for these results could be that the act of typing online is actually effective in reducing participants' stress. Social media has been shown to increase self-esteem and particularly opportunities for self-disclosure amongst young people (Best, Manktelow, & Taylor, 2014). The participants in the current study could have been interacting with the Google-Talk portion of the experiment in the same positive way. The participants could have focused on the positive content regarding their dream job, rather than being distracted by another's negative evaluation. Lipinski-Harten & Tafarodi (2012) found that, in a comparison of online and in-person conversations, online chat produced greater self-focus and less other-focus than did face-to-face conversation. It is possible that participants in the current study attended less to the experimenter's non-positive evaluation and more to their own positive formulation of how they are the best candidate for their dream job. The current results build upon previous research showing how online interactions that involve personal communication can be beneficial even with a neutral and low rate of feedback.

Emotion Identification

For the second aim of the study, it was hypothesized that increased social stress would cause participants to identify angry-fearful ambiguous faces as more angry than fearful. Stress condition did not impact emotion identification across all participants. However, men were more likely than women to interpret ambiguous angry-fearful faces as angry when less stressed. In the higher stress condition (TSST), men and women did not differ in their emotion identification. This suggests that in typical, everyday contexts, men are more inclined to perceive anger than women. In stressful contexts, this bias was diminished, thus men and women were equally likely to identify anger versus fear.

The gender differences of these results countered the results of Wieser et al. (2010), which found that both men and women were inclined to process angry faces better when they were anticipating social stress. The key difference between Wieser et al. (2010) and the current study is that Wieser et al. only elicited *anticipatory* stress, rather than eliciting actual stress through the full TSST. Experiencing social stress may more strongly influence gender differences in emotion perception than merely anticipating negative evaluations.

Post hoc analyses also identified a gender difference in ability to identify unambiguous fearful faces. Female participants were significantly better able to identify true fearful faces than male participants, some of whom incorrectly labeled fear as anger. This finding supports broader research on gender differences in emotion identification abilities.

Lee et al. (2014) report that women are better at identifying all emotional expressions, and Williams et al. (2009) found that women were better than men at identifying fearful faces specifically.

These patterns may be due to the ways in which men and women are socialized differently. Male children are often socialized to avoid expressing vulnerable emotions; when they begin to feel vulnerable emotions, they often use aggression as a strategy for regulation. Chaplin, Cole, and Zahn-Waxler (2005) examined parental interactions with 4- to 6-year old children for just ten minutes and found gender differences in emotion expression. Girls expressed more sadness and anxiety than boys and boys displayed more anger than girls; parental attentiveness supported these gender differentiated emotional expressions. Because men trend towards expressing anger instead of fear, this develops into men more strongly identifying anger in facial expressions than women. Jakupcak (2005) found that men's fear of emotions was a significant predictor of overt hostility, anger expression, and diminished anger control. Rotter & Rotter (1988) found that men were superior to women in recognizing angry expressions; similarly, Larkin, Martin, and McClain (2002) found that men were more likely than women to label facial expressions of disgust as anger. Men's socialization towards expressing and identifying angry expressions helps to explain why male participants were more likely to identify anger in ambiguous faces and misidentified true fear as anger.

With greater stress (the TSST condition), men and women were nearly equal in their identification of anger versus fear in ambiguous facial expressions. This outcome mirrors a study by DeDora, Carlson, and Mujica-Parodi (2011) in which participants experienced the acute stressor of a first-time tandem skydive and had to identify morphed aggressive-neutral faces during the plane's ascent. They found that, when undergoing stress, there were no significant differences between men and women in their identification of facial affect. Experiencing acute stress may override the effects of gender socialization.

Limitations and Future Directions

One limitation of the present research was that the sample size was small and only included college students; these findings may not extend to a wider, more diverse population. Another limitation was the self-report nature of the stress evaluation. Multiple methods of assessing emotions, such as physiological and observational, often provide a more complete picture of experienced emotions than self-report alone (Sideridis, Kaplan, Papadopoulous, & Anastasiadis, 2014).

Future directions could explore how physiological measurements of stress correlate with self-reported stress for the e-Trier, as the development of an online social stress elicitation continues. Additionally, the use of imaging methods during the emotion identification stage could reveal whether men and women differ in their processing of angry-fearful ambiguous faces and true fearful faces both in and outside of stressful contexts.

Conclusion

The present study explored the effectiveness of eliciting social stress with an online, text-based version of the Trier Social Stress Test, called the e-Trier. The e-Trier was effective in eliciting stress via arithmetic, but the speech equivalent of the e-Trier decreased stress to baseline levels. These results suggest a new area of exploration regarding the stress properties of online communication in comparison with face-to-face communication. The present study also examined how social stress impacted emotion identification; in non-stressful conditions,

men were prone to identifying ambiguous expressions as significantly angrier than women, but under stress that gender difference disappeared. The findings emphasize socialization toward aggression in men, but add complexity in showing that social stress may eliminate rather than enhance this bias.

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Appendix

Table 1

Means and Standard Deviations for Anxiety Measures and Baseline Stress

	TSST	e-Trier	Control	Group Comparison
	N = 21	N = 18	N = 19	
	M(SD)	M(SD)	M(SD)	
STAI-T	46.48 (3.50)	47.72 (4.07)	46.05 (3.31)	$F(2, 57) = 1.056$, $p = 0.355$
FNE	36.71 (10.06)	38.61 (9.25)	38.58 (11.44)	$F(2, 57) = 0.223$, $p = 0.801$
Baseline Stress	39.71 (23.59)	43.89 (21.07)	31.26 (21.95)	$F(2. 57) = 1.554$, $p = 0.221$

Note. TSST = Trier Social Stress Test; STAI-T = State-Trait Anxiety Inventory – Trait; FNE = Fear of Negative Evaluations.

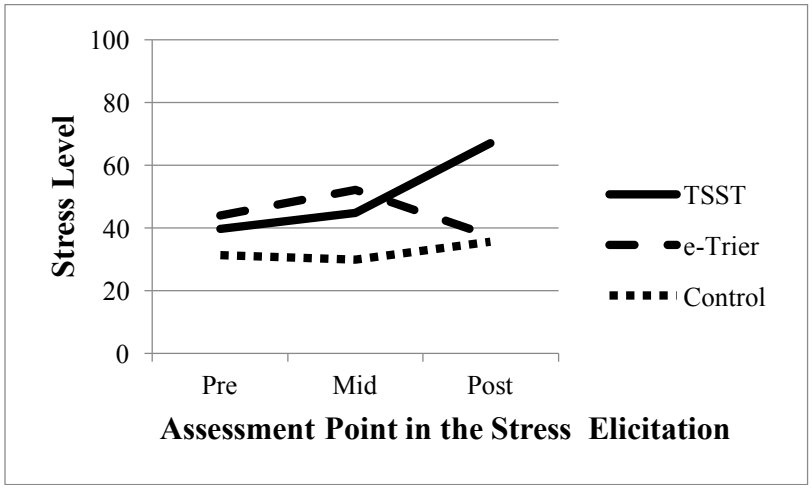

Figure 1. Stress self-evaluation by condition across the stress elicitation.

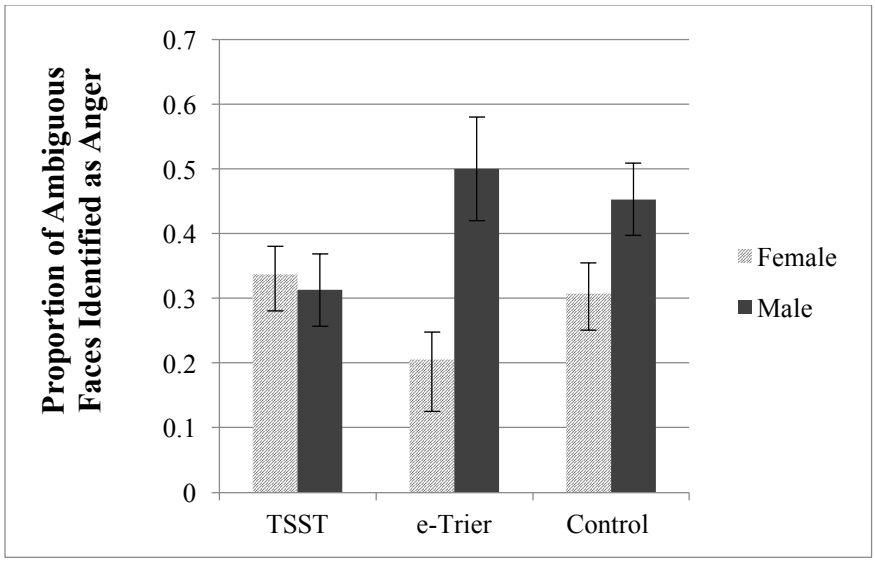

Figure 2. Gender by condition in emotion identification of morphed faces. Error bars represent standard errors.

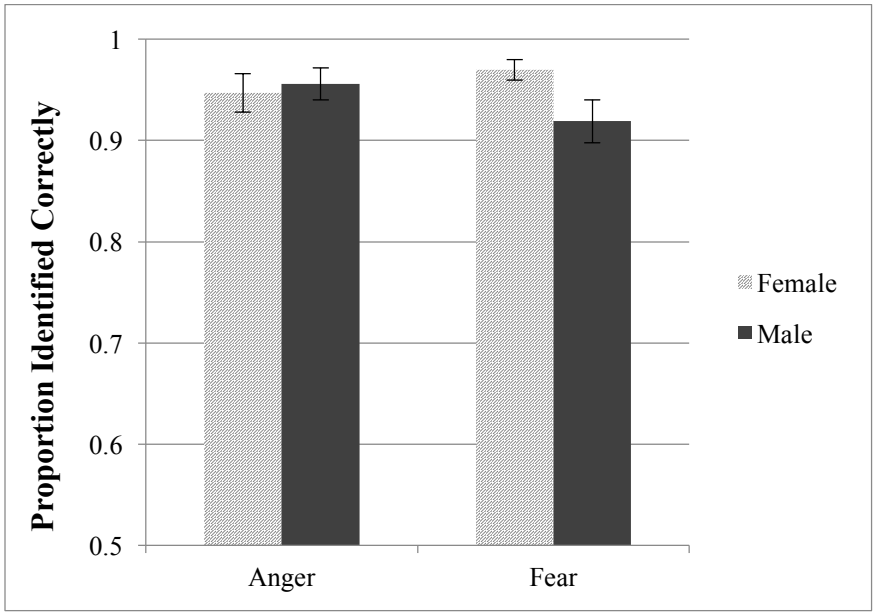

Figure 3. Gender in emotion identification of true, un-morphed angry and fearful faces. Error bars represent standard errors.