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Military Affective Picture System (MAPS): A new emotion-based stimuli set for assessing emotional processing in military populations

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ABSTRACT

Background and objectives: Emotionally relevant pictorial stimuli utilized in studies to characterize both normal and pathological emotional responses do not include military scenarios. Failures to replicate consistent findings for military populations have led to speculation that these image sets do not capture personally relevant experiences.
Methods: The Military Affective Picture System (MAPS) was developed consisting of 240 images depicting scenes common among military populations. A Self-Assessment Manikin was administered to a 1) U.S. Army soldiers and a 2) non-military population.
Results: Findings revealed gender differences in valence and dominance dimensions, but not arousal, for both samples. Valence scores were higher for the military. Arousal ratings decrease as a product of combat exposure. Civilian females demonstrated stronger correlations of valence and arousal when viewing positive or negative images.
Limitations: Given the limited power achieved in the current studies' gender comparisons; it would be difficult to draw major conclusions regarding the interaction of combat exposure or military status with gender for each of the categories. Without having included the IAPS ratings for comparison it is difficult to conclude whether effects only pertain to viewing MAPS images, or if there was unintentional selection bias. Additional ratings would provide better assessments for these effects in both males and females.
Conclusions: The MAPS has potential as a screening instrument and clinical evaluation tool for assessing treatment outcomes for individuals with combat-related psychopathology. The MAPS is freely available for research to non-profit groups upon request at http://www.cla.auburn.edu/psychology/military-affective-picture-system/.

1. Introduction

Abnormal emotional responses are a staple of many neuropsychiatric disorders. Posttraumatic stress disorder (PTSD) criteria include disturbances categorized as re-experiencing, avoidance, negative cognitions and mood, and hyperarousal attributed to differences observed in the prefrontal cortex and limbic system (Newport & Nemeroff, 2003). As known with PTSD (Ashley, Honzel, Larsen, Justus, & Swick, 2013), emotions are often context-specific, based on environmental exposure throughout the lifespan of the individual (Nelson, Lau, & Jarcho, 2014). Context-specific emotions can be difficult to reproduce in the laboratory, but necessary for understanding mechanisms involved in healthy and abnormal emotional processes.

Lang, Bradley, and Cuthbert (1997) developed the International Affective Picture System (IAPS) to measure affective reactions to visual stimuli in the form of photographs that depict scenes and events with people and entities. The IAPS provides a range of stimuli with established normative ratings from the general population that capture a range of human emotional responses varying in valence (i.e., positive, negative, and neutral) and intensity (e.g., a range between high and low). The existing picture set includes over 1000 pictures, with images ranging from familiar objects, such as people and events, to physically revolting content (e.g., mutilated bodies). The IAPS contains subsets of image categories such as

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snake or spider (Courtney, Dawson, Schell, Iyer, & Parsons, 2010), sexually explicit (Levenston, Patrick, Bradley, & Lang, 2000), and injury (Hermann et al., 2007) which were selected to study particular pathological responses.

The IAPS has excellent utility and serves as a standard in the study of emotion. Yet, the wide range of emotion-relevant contexts surpasses current techniques in the mere quantity and abundance of affective contexts (Dan-Glauser & Scherer, 2011; Marchewka, Żurawski, Jednoróg, & Grabowska, 2014). Accordingly, several other image sets have recently been developed to address limitations of the IAPS. Dan-Glauser and Scherer (2011) developed a novel inventory of affective images and normed ratings known as the Geneva affective picture database (GAPED). The GAPED introduced an image set with greater within-context image quantities, thus avoiding potential habituation effects caused by repeated exposure to identical emotion-relevant images. Categories of GAPED images include snakes, spiders, human concerns (i.e., scenes depicting violations of human rights), and animal mistreatments which are asserted to be ideally suited for studying affective response irregularities of particular pathological underpinnings, such as specific phobias (Dan-Glauser & Scherer, 2011). More recently, the Nencki affective picture system (NAPS) was introduced by Marchewka et al. (2014). In addition to expanded context-specific images, the NAPS includes only high-resolution images with minimum resolutions of 1200×1600 (landscape) or 1600×1200 (portrait), which are argued to better reflect contemporary digital picture quality experienced by most individuals on a daily basis. Additionally, the NAPS provides equivalent quantities of negative and positive scenes, thus allowing counterbalancing of valence for experimental designs (Marchewka et al., 2014). Gender effects explored for IAPS (Bradley, Codispoti, Sabatinelli, & Lang, 2001) and NAPS (Marchewka et al., 2014) have consistently shown increased valence and arousal ratings for males viewing positive images (i.e., appetitive motivation); and decreased mean valence but increased arousal (i.e., defensive motivation) for females viewing negative images. These gender effects strongly suggest that this factor should be taken into consideration by investigators examining responses to affective images. The GAPED and NAPS have demonstrated that there is an ongoing need for establishing relevant stimuli for eliciting context-specific emotions in populations not well represented in available affective image sets. One such population known to be exposed to unique environmental conditions are military service members.

Affective image sets (mainly IAPS) have been employed in experimental studies of emotion among clinical populations characterized by affective dysregulation, such as mood (Johnstone, van Reekum, Urry, Kalin, & Davidson, 2007), anxiety (Pacheco-Unguetti, Acosta, Callejas, & Lupiáñez, 2010), and personality disorders (Koenigsberg et al., 2009). However, with the high prevalence of neuropsychiatric illness in military service members returning from deployments, a limitation of existing affective image sets is that they do not contain combat-relevant stimuli related to deployment and training environments. This absence may preclude replication of emotional abnormalities when examined in military samples. For example, PTSD is characterized in civilian populations by emotional numbing, or a generalized reduction in subjective or physiological responses to evocative stimuli, as compared to controls. However, several investigations have reported that such pathological differences have not been observed in replications with PTSD in combat veterans most likely due to the lack of a personally relevant stimuli for combat–exposed veterans (Amdur, Larsen, & Liberzon, 2000; Wolf, Miller, & McKinney, 2009). In addition, evidence gathered from U.S. war veterans diagnosed with PTSD shows pathological differences in attentional bias using an Emotional Stroop task emerge with regard to processing of trauma-related words only when distractors were combat-related, as compared to other negative distractors (Ashley et al., 2013; for an alternative explanation see Iacoviello et al., 2014).

A strong demand for emotion research in military populations currently exists, with estimates of PTSD at 13.8% among U.S. soldiers returning from deployments to Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) (Tanielian & Jaycox, 2008). For the reasons mentioned above, a novel set of military-based images were normed using male and female participants from both military and non-military populations. Although dominance ratings were collected in the original IAPS studies, much of the ensuing literature and research focused on valence and arousal. Because the current study sought to replicate these studies procedurally, dominance measures were collected purely for replication purposes. We hypothesized that emotional responses across each of the dimensions will differ significantly between military and non-military populations based on prior affective image research. Likewise, we expected significant gender differences in ratings of MAPS images.

2. Method

2.1. Participants

A total of 377 participants, 201 military and 176 civilians, were recruited for the study via information disseminated by their respective leadership on a military installation. All participants provided written informed consent before enrollment. The military sample consisted of active-duty, U.S. Army soldiers, both with and without a history of deployment to OIF/OEF. A separate civilian sample ($n = 176$) composed of undergraduates at Auburn University, Alabama were recruited using an online system (http://auburn.Sona-systems.com). Exclusionary criteria (Supplementary Materials S1) was implemented and intended to remove influences on normative ratings caused by individuals who did not complete the entirety of the procedure or who may be experiencing PTSD or post-concussive symptoms. After this exclusionary process, $n = 129$ civilian participants and $n = 165$ military participants remained for data analysis.

2.2. Stimuli

The Military Affective Picture System (MAPS), developed by the U.S. Army Aeromedical Research Laboratory (USAARL), consists of a set of 240 images containing military deployment-related content. Images were cropped to a relative high resolution at approximately 1024×768 pixels or 768×1024 pixels for landscape and portrait orientations, respectively. The high resolution ensured visibility comparable to contemporary digital media (c.f., Marchewka et al., 2014). Images were determined by experimenters to belong to one of four categories as intended to elicit either a positive or negative reaction accompanied by either a high or low state of arousal (positive/high, positive/low, negative/high, negative/low; See Supplement S1 for procedure). This assignment was used to ensure counterbalancing across affective space for each of four presentation subsets, each containing 60 of the 240 total images. Subsets were created to avoid low levels of interests caused by exposing participants to an abundance of images (Dan-Glauser & Scherer, 2011). Each image was presented to a minimum of 25 participants from each sample in order to solicit the ratings required to establish normative reaction values for both populations.

2.3. Procedure

Military and civilian participants were tested in groups ranging from 5 to 40 based on the number of individuals who elected to participate during designated timeslots. All participants were informed that they could withdraw from the study at any time, for any reason, with no consequences whatsoever. After informed consent was obtained, participants began completing a demographic questionnaire which included information about their background and personal experiences. Participants in both the military and civilian samples completed respective versions of the PTSD Checklist-Military Version (PCL-M) and the PTSD Checklist-Civilian Version (PCL-C; http://www.ptsd.va.gov). Both the military and civilian samples were tested in a quiet classroom.

The MAPS image presentation and rating procedure was automated using PowerPoint (Microsoft Corporation, 2010). For each MAPS image presented, participants were asked to use the Self-Assessment Manikin (SAM) to rate the picture on perceived factors of valence, arousal, and dominance (Bradley & Lang, 1994). All participants were given verbal instructions on viewing and rating the images and four practice slides prior to beginning MAPS images ratings (See Supplementary Materials S1). The duration of the image presentation and rating procedure lasted approximately 35 min. Both the SAM ratings and MAPS presentation procedures were consistent with those described in the Lang, Bradley, and Cuthbert (2008) report.

2.4. Data preparation and analysis

Participant data from both studies with the military sample and civilian sample were culled and aggregated for a total sample size of 377 participants. All coding and analyses were performed using SPSS 22 (IBM) and Excel (Microsoft Corporation, 2013). Response data were coded on a 1 (low) to 9 (high) scale, to reflect scores for valence, arousal, and dominance associated with each image consistent with the IAPS report (Lang et al., 2008). Once coded, means were calculated on an individual subject basis for the 15 images from each of the four image categories which they rated. This calculation produced four mean values for positive valenced, high arousal (positive/high); positive valenced, low arousal (positive/low); negative valenced, high arousal (negative/high); and negative valenced, low arousal (negative/low) for each subject. Each subject was also coded for a between-subjects group comparison based on self-reports of gender ("male" or 'female") and whether they have ever deployed to a combat zone ("Yes" or "No") from the demographic survey. This group coding produced six groups including female civilians, non-combat exposed female military, combat exposed female military, male civilian, non-combat exposed male military, and combat exposed male military. Because only a limited sample of combat exposed females ($n = 2$) elected to participate in the current study, the mean SAM ratings for combat exposed female military were not reported or submitted to any statistical analysis. The mean valence, arousal, and dominance ratings for each the remaining five groups (female civilians, non-combat exposed female military, male civilian, non-combat exposed male military, and combat exposed male military) were characterized by assessing mean (*M*) and standard deviation (*SD*) SAM ratings for each of the 240 images.

In order to assess image category, group, gender and their interactions, mixed-model ANOVAs for valence, arousal, and dominance were used. In order to separately assess the effects of combat exposure and military experience for male participants, category, group and their interactions were assessed using mixed-model ANOVAs for valence, arousal, and dominance. Greenhouse-Geisser corrected degrees of freedom were used for violations of assumptions of spherecity. All post-hoc comparisons were adjusted with Bonferroni corrections to reduce the likelihood of inflated Type I error rate associated with multiple comparisons (See Supplimentary Materials S1 for results of these comparisons).

3. Results

The final sample sizes and results of the demographic questionnaire for each of the five samples are presented in Table 1. Based on the demographics reported in Table 1, the current studies' experimental participants mostly self-identified as "White". Also, the proportion of males to females appeared to differ significantly between military and civilian samples. A One-way ANOVA of Male Groups (Civilian, Non-Combat Exposed, and Combat Exposed) on Age revealed that this factor differed significantly between each of the male groups, $F\ (2,\ 181) = 84.39$, $p < .001$, $\eta^2 = .49$. Because of this finding, subsequent analyses comparing these male groups were conducted with and without the factor of age added as a covariate. The normative valence, arousal, and dominance scores of each of the 240 MAPS images are shown in Table S2 for the female civilian sample, Table S3 for the male civilian sample, Table S4 for the female non-combat exposed group, Table S5 for the male non-combat exposed group, and Table S6 for the male combat exposed group in the Supplemental Material available online.

3.1. Rating differences by, category, group and gender

3.1.1. Valence ratings

Fig. 1 shows mean valence ratings for male and female civilians and non-combat military. Mean valence ratings decreased across categories from *positive/high* ($M = 6.22$, $SD = 0.66$), to *positive/low* ($M = 5.82$, $SD = 0.60$), to *negative/low* ($M = 4.57$, $SD = 0.63$), to *negative/high* ($M = 2.93$, $SD = 0.81$) regardless of group or gender. Overall mean valence ratings were higher for non-combat military ($M = 5.11$, $SD = 0.36$) than civilian ($M = 4.72$, $SD = 0.44$) participants. Overall mean valence ratings were also higher for males ($M = 5.13$, $SD = 0.38$) than females ($M = 4.64$, $SD = 0.40$). Males and females differed in overall mean valence ratings only for the two unpleasant image categories. For civilians, gender differed in both of the negative image categories, but not the positive categories, whereas for non-combat military there was only a small gender difference for the *positive/high* category. These findings were confirmed by a three-way mixed model ANOVA of Gender (male, female) × Group (non-combat military, civilian) × Category (positive/high, positive/low, negative/high, negative/low) on mean valence ratings, which yielded a significant three-way Gender × Group × Category interaction, $F\ (1.83, 446.43) = 10.34$, $p < .001$, $\eta^2_p = .04$, an interaction of category and gender, $F\ (1.83, 446.43) = 4.62$, $p < .05$, $\eta^2_p = .02$, a main effect of category, $F\ (1.83, 446.43) = 889.21$, $p < .001$, $\eta^2_p = .79$, a main effect of group, $F\ (1, 244) = 35.40$, $p < .01$, $\eta^2_p = .03$, and a main effect of gender, $F\ (1, 244) = 19.68$, $p < .001$, $\eta^2_p = .13$. The remaining interactions were not significant, $Fs \leq 1.52$, $ps > .22$.

3.1.2. Arousal ratings

Fig. 2 shows mean arousal ratings for male and female civilians and non-combat military. Mean arousal ratings decreased across categories for from *negative/high* ($M = 5.03$, $SD = 1.65$), to *positive/high* ($M = 4.14$, $SD = 1.55$), to *negative/low* ($M = 3.73$, $SD = 1.38$), to *positive/low* ($M = 3.57$, $SD = 1.41$). Overall mean arousal ratings were higher for civilian ($M = 4.38$, $SD = 1.68$) than non-combat military ($M = 3.84$, $SD = 1.20$) participants. These findings were

Table 1
Summarizes sample and group composition based on number, age, gender, ethnicity, and education.

Demographics						
Sample	Gender	Combat exposure	n	Age	Ethnicity	Education
Civilian	Female	No	n = 96	M = 20.49, SD = 1.60	White, n = 85; Other, n = 11	12–13 years, n = 61; 14–16 years, n = 34; >16 years, n = 1
	Male	No	n = 33	M = 21.00, SD = 1.84	White, n = 25; Other, n = 8	12–13 years, n = 24; 14–16 years, n = 9; >16 years, n = 0
Military	Female	No	n = 16	M = 24.13, SD = 3.12	White, n = 14; Other, n = 2	12–13 years, n = 1; 14–16 years, n = 15; >16 years, n = 0
	Male	No	n = 103	M = 23.93, SD = 2.84	White, n = 92; Other, n = 11	12–13 years, n = 7; 14–16 years, n = 96; >16 years, n = 3
	Male	Yes	n = 46	M = 28.76, SD = 3.03	White, n = 42; Other, n = 4	12–13 years, n = 8; 14–16 years, n = 77; >16 years, n = 2

confirmed by a three-way mixed model ANOVA of Gender (male, female) × Group (non-combat military, civilian) × Category (positive/high, positive/low, negative/high, negative/low) on mean arousal ratings, which yielded a main effect of category F (1.67, 406.67) = 102.51, $p < .001$, $\eta_p^2 = .27$, and group, F (1, 244) = 8.316, $p < .01$, $\eta_p^2 = .03$. The remaining main effect and interactions were not significant, all Fs < 1.52, all ps > .21.

3.1.3. Dominance ratings

Fig. 3 shows mean dominance ratings for male and female civilians and non-combat military. Mean dominance ratings were equivalent for *positive/low* (M = 6.18, SD = 1.72) and *positive/high* (M = 6.05, SD = 1.69), and decreased to *negative/low* (M = 5.69, SD = 1.73) to *negative/high* (M = 4.47, SD = 1.83). Overall dominance ratings were greater for non-combat military (M = 6.37, SD = 1.42) than civilian (M = 4.89, SD = 1.38) participants. Males and females differed in overall mean dominance ratings for civilian participants, but not for non-combat military participants. For civilians, mean dominance ratings decreased from *positive/high*, to *positive low*, to *negative/low*, to *negative/high*. For non-combat military, mean dominance ratings decrease from *positive/low*, to *positive/high* which was equivalent with *negative/low*, to *negative/high*. These findings were confirmed by a three-way mixed model ANOVA of Gender (male, female) × Group (non-combat military, civilian) × Category (positive/high, positive/low, negative/high,. negative/low) on mean dominance ratings, which yielded a

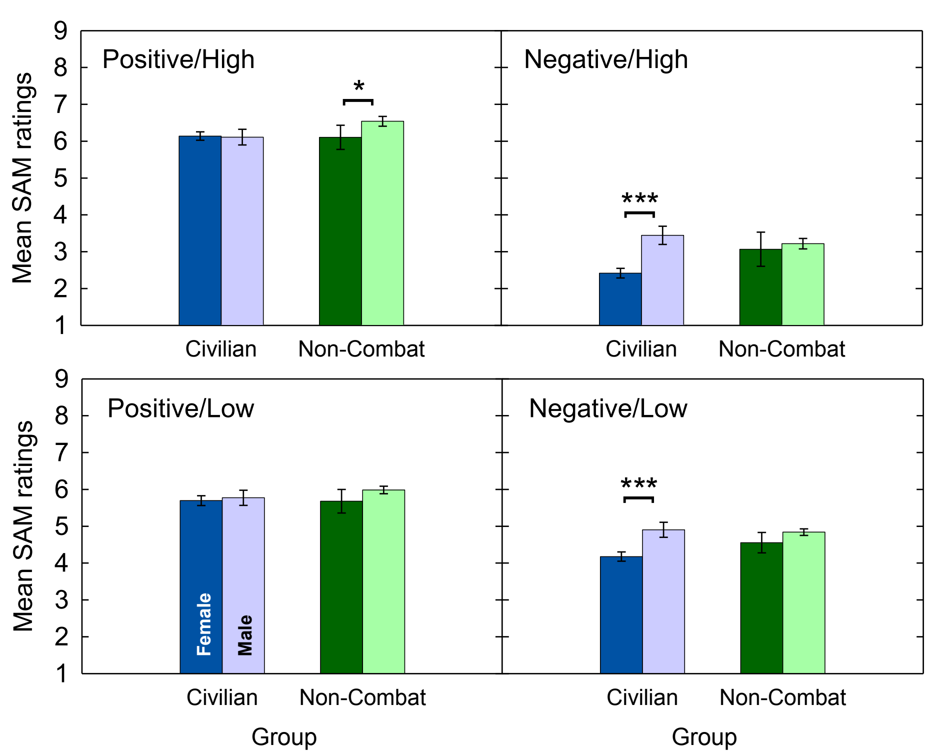

Fig. 1. Valence. Mean valence ratings for male and female civilians and non-combat military, separated by image categories with positive valence in the left panels, negative valence in the right panels, high arousal in the upper panels, and low arousal in the lower panels. Female ratings are shown in darker bars and male ratings are shown in lighter bars. Lower values indicate decreased feelings and higher values indicated increased feelings. Error bars represent confidence intervals (CI).*$p < .05$; ***$p < .001$.

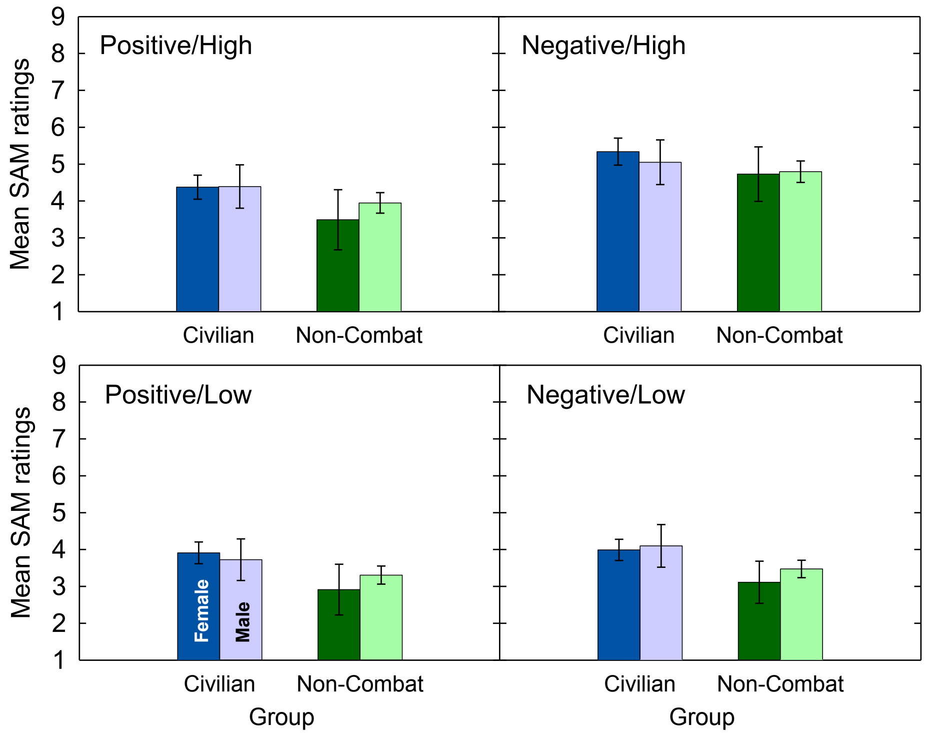

Fig. 2. Arousal. Mean arousal ratings for male and female civilians and non-combat military, separated by image categories with positive valence in the left panels, negative valence in the right panels, high arousal in the upper panels, and low arousal in the lower panels. Female ratings are shown in darker bars and male ratings are shown in lighter bars. Lower values indicate decreased feelings and higher values indicated increased feelings. Error bars represent confidence intervals (CI).*$p < .05$.

significant interaction of category and group, $F(1.53, 327.21) = 6.93$, $p < .01$, $\eta_p^2 = 0.03$, a significant interaction of gender and group, $F(1.53, 327.21) = 4.58$, $p < .05$, $\eta_p^2 = .02$, a main effect of group, $F(1, 244) = 31.01$, $p < .001$, $\eta_p^2 = .11$, and a main effect of category, $F(1.53, 327.21) = 6.932$, $p < .001$, $\eta_p^2 = .33$. The remaining main effect and interactions were not significant, all Fs < 3.17, all ps $> .07$.

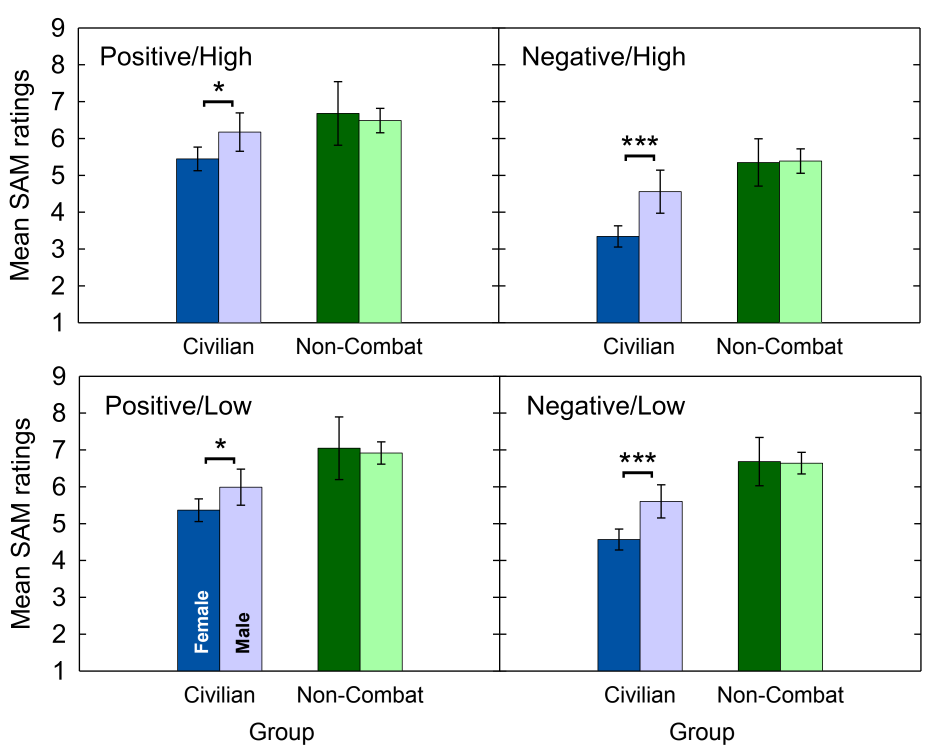

Fig. 3. Dominance. Mean dominance ratings for male and female civilians and non-combat military, separated by image categories with positive valence in the left panels, negative valence in the right panels, high arousal in the upper panels, and low arousal in the lower panels. Female ratings are shown in darker bars and male ratings are shown in lighter bars. Lower values indicate decreased feelings and higher values indicated increased feelings. Error bars represent confidence intervals (CI).*$p < .05$; ***$p < .001$.

3.2. Rating differences by category and combat exposure

3.2.1. Valence ratings

Fig. 4 shows mean valence ratings for civilian, non-combat exposed military, and combat exposed military males. Mean valence ratings decreased across categories from *positive/high* ($M = 6.40$, $SD = 0.70$), to *positive/low* ($M = 5.89$, $SD = 0.56$), to *negative/low* ($M = 4.87$, $SD = 0.53$), to *negative/high* ($M = 3.39$, $SD = 0.78$). Group differences in overall mean valence ratings were only found between non-combat military males and civilian males for the *positive/high* category, and between combat exposed military males and non-combat exposed military males for the *negative/high* category. These findings were confirmed by a two-way mixed model ANOVA of Group (male civilian, male non-combat military, male combat military) × Category (positive/high, positive/low, negative/high, negative/low) on mean valence ratings which yielded a significant two-way Group × Category interaction, $F(3.22, 287.70) = 7.37$, $p < .001$, $\eta_p^2 = .08$. A main effect of category, $F(1.61, 287.70) = 430.77$, $p < .001$, $\eta_p^2 = .79$, confirmed that mean valence ratings differed across the four image categories. The remaining main effect of group, $F(2, 179) = 0.99$, $p = .37$, was not significant. The same two-way mixed-model ANOVA conducted with Age as a covariate found that overall valence ratings did not vary as a function of age, $F(1, 178) = 0.30$, $p = .58$.

3.2.2. Arousal ratings

Fig. 4 shows mean arousal ratings for civilian, non-combat exposed military, and combat exposed military males. Mean arousal ratings decreased across category from *negative/high* ($M = 4.60$, $SD = 1.63$), to *positive/high* ($M = 3.79$, $SD = 1.55$), to *negative low* ($M = 3.42$, $SD = 1.39$), to *positive/low* ($M = 3.19$, $SD = 1.37$). Mean arousal ratings did not differ significantly between male civilian participants ($M = 4.32$, $SD = 1.55$) and non-combat male military participants ($M = 3.88$, $SD = 1.28$), however, both of these groups were greater than combat male military participants ($M = 3.05$, $SD = 1.34$). These findings were confirmed by a two-way mixed model ANOVA of Group (male civilian, male non-combat military, male combat military) × Category (positive/high, positive/low, negative/high, negative/low) on mean arousal ratings, which yielded a main effect of category $F(1.87, 333.43) = 114.33$, $p < .001$, $\eta_p^2 = .39$, a main effect of group, $F(2, 179) = 10.17$, $p < .001$, $\eta_p^2 = .10$, and no interaction. The same two-way mixed-model ANOVA conducted with Age as a covariate found that overall arousal ratings did not vary as a function of age, $F(1, 178) = 0.53$, $p = .47$.

3.2.3. Dominance ratings

Fig. 4 shows mean dominance ratings for civilian, non-combat exposed military, and combat exposed military males. Mean dominance ratings decreased across categories from *positive/high* ($M = 6.40$, $SD = 0.70$), to *positive/low* ($M = 5.89$, $SD = 0.56$), to *negative/low* ($M = 4.87$, $SD = 0.53$), to *negative/high* ($M = 3.39$, $SD = 0.78$). Overall mean dominance ratings increased across civilian ($M = 5.58$, $SD = 1.28$), non-combat exposed military ($M = 6.35$, $SD = 1.44$), and combat exposed military males ($M = 6.99$, $SD = 1.81$). For the *positive/low* category, mean dominance ratings were lower for civilian males than both the non-combat exposed military and combat exposed military males. For the *negative/high* category, mean dominance ratings for combat exposed military males were greater than both civilian males and non-combat exposed military males. For the *negative/low* category, mean dominance ratings decreased from combat exposed military males, to non-combat exposed military males, to civilian males. These results were confirmed by a two-way mixed model ANOVA of

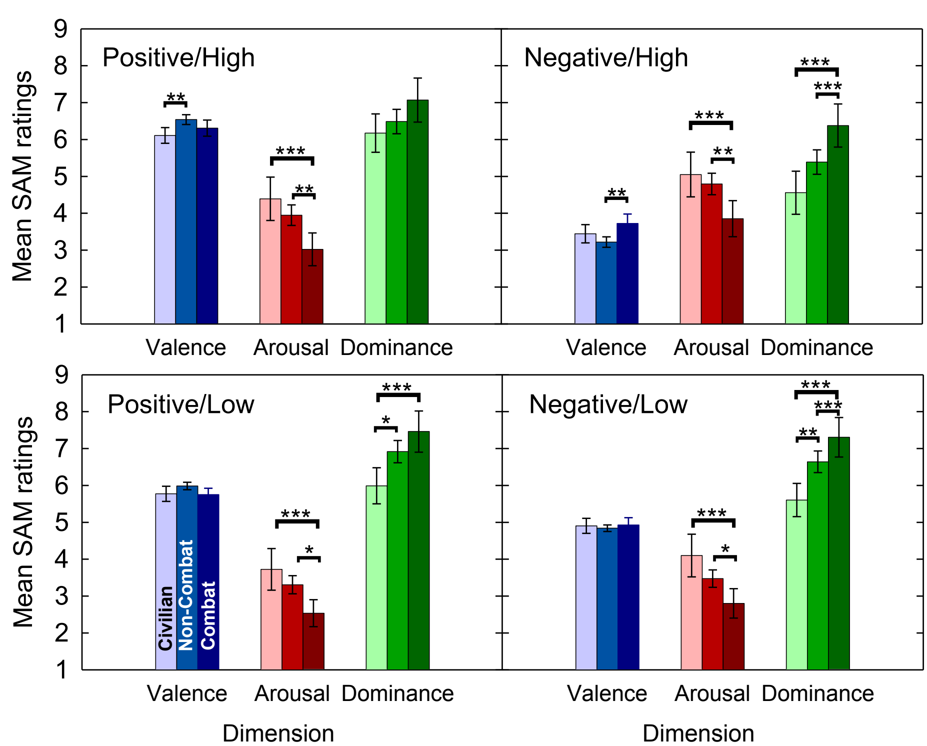

Fig. 4. Military Status and Combat Exposure. Mean valence, arousal, and dominance ratings for civilian, non-combat exposed, and combat exposed military participants, separated by image categories with positive valence in the left panels, negative valence in the right panels, high arousal in the upper panels, and low arousal in the lower panels. Civilian male ratings are shown in the lightest bars, non-combat exposed military male ratings are shown in the middle bars, and combat exposed military male ratings are shown in the darkest bars. Lower values indicate decreased feelings and higher values indicated increased feelings. Error bars represent confidence intervals (CI).*$p < .05$; **$p < .01$; ***$p < .001$.

Group (male civilian, male non-combat military, male combat military) × Category (positive/high, positive/low, negative/high, negative/low) on mean dominance ratings, which yielded a significant two-way Group × Category interaction, F (3.13, 280.45) = 3.60, $p < .05$, $\eta_p^2 = .04$, a main effect of category F (1.57, 280.45) = 87.12, $p < .001$, $\eta_p^2 = .33$, a main effect of group, F (2, 179) = 9.03, $p < .001$, $\eta_p^2 = .09$, and no interaction. The same two-way mixed-model ANOVA conducted with age as a covariate found that overall dominance ratings varied significantly as a function of age, F (1, 178) = 5.32, $p < .05$, $\eta_p^2 = .03$. Additionally, the inclusion of age as a covariate attenuated the effects of Group, F (2, 178) = 1.43, $p = .24$, and Category F (1.57, 280.45) = .24, $p = .73$, but not the Group × Category interaction, F (3.13, 280.45) = 4.28, $p < .01$, $\eta_p^2 = .05$.

3.3. Affective space

In order to compare the current studies results to other examinations of published emotional-relevant image sets, a least-squares regression analyses was used to assess relationships within each group, between valence and arousal for each of the 240 images. The resulting correlation coefficients and scatterplots of these relationships can be seen in Fig. 5. Correlation coefficients for each group were then compared to all other groups independently for both positive and negative images using a Fisher's r-to-z transformation (Cohen & Cohen, 1983). These methods (See Supplement S1) were adapted from approaches utilized in prior studies (Bradley et al., 2001; Marchewka et al., 2014) and allowed for the examination of group differences in appetitive and defensive motivation when viewing the MAPS.

3.3.1. Comparison of correlation coefficients

Civilian females showed significantly stronger correlations for positive images as compared to civilian male, non-combat military male, and combat male groups with all $zs > 4.51$, all $ps < .01$. Non-combat military females also showed a significantly stronger correlation than civilian males, $z = 2.59$, $p < .01$. Relative to the comparison of combat and non-combat military males (z = .11, all p = .92) comparisons of military males with civilian males (both $zs > 1.48$, both $ps < .14$) revealed greater, but not statistically different coefficients. All other group comparisons of coefficients for positive images were not significant with $zs < 1.20$, all $ps > .07$. Civilian females showed significantly stronger correlations for negative images as compared to all other groups with all $zs > 2.93$, all $ps < .01$. All other group comparisons of coefficients for negative images were not significant with $zs < 1.03$, all $ps > .30$.

4. Discussion

The current study was successful at norming a set of military emotion-based pictures, the MAPS. Image categories were shown to differ for the valence, arousal, and dominance dimensions. Ratings differed as a function of gender, civilian vs. military status, and combat exposure. Specifically, civilians tended to have lower ratings in pleasantness (e.g., happy, contented, pleased) than soldiers, regardless of whether soldiers had combat exposure or not. Civilian participants had the highest arousal ratings irrespective of category. For dominance ratings, higher reports of feeling “in-control” in the order of lowest to highest were reported across civilian, non-combat exposed male soldiers, and combat exposed male soldiers, however this effect was diminished when the comparisons were controlled for age. Also of note, gender differences were greater between civilian males and females than for non-combat military males and females.

4.1. Category

The current study's results confirmed that the four experimenter determined image categories accurately reflected the mean ratings reported by participants across all five groups. There were graded differences for both valence and arousal across categories with relatively large mean differences and effect sizes between both the two negative image categories for valence ratings (negative/high, negative/low) and the two high arousal image categories (negative/high, positive/high). Although the positive image categories (positive/high, positive/low) and the two, low arousal image categories (positive/low, negative/low) means did not differ as greatly, the post-hoc analysis still yielded significant results from these comparisons. Regardless, both the positive valence categories and the high arousal categories had higher ratings than both the negative and low arousal categories, irrespective of gender, military status, or combat exposure.

4.2. Gender

The most striking finding concerning gender differences was that non-combat military male and female participants only had significant differences for valence ratings in one category: pleasant arousing images. Conversely, civilian males in the current study reported higher valence ratings for both negative/high and negative/low image categories and dominance ratings across all four categories. These results suggest that when military participants without combat exposure viewed MAPS images, males and females mostly reported similar affective responses in all but the pleasant arousing category. In examining responses for the pleasant arousing category across groups and gender, participants' responses when rating valence were significantly different for military non-combat males and females, but not for civilian males and females. Nor were there gender differences for non-combat military participants with respect to the arousal or dominance dimensions. Our findings in our civilian sample may appear to contradict Bradley et al. (2001) which demonstrated males reporting overall higher valence, but lower arousal than females when viewing IAPS images. However, these effects were present for some IAPS image categories (e.g., erotic couples, opposite sex erotica, human attacks), but not all (e.g., household objects, food, sports). Because the MAPS contains images of a completely different nature, combat images with no eroticism (and only combat related injuries), it is not surprising that our results are different from Bradley et al. (2001) with respect to gender for the valence and arousal dimensions.

In the current study, gender effects were also explored using distributions of affective space. Prior findings using IAPS, (Bradley et al., 2001) revealed relatively weak couplings of valence and arousal ratings for women viewing pleasant images and men viewing unpleasant images and strong couplings for women viewing unpleasant images and men viewing pleasant pictures. In accord with Bradley et al. (2001), our findings showed strong couplings for ratings while viewing unpleasant MAPS images by males, regardless of military status or combat exposure. However, unlike Bradley et al., strong couplings were observed for female ratings while viewing pleasant MAPS images, regardless of military status. Furthermore, males tended to report with weak couplings between pleasure and arousal while viewing pleasant MAPS images by males. Results obtained for the NAPS image set (Marchewka et al., 2014) also revealed inconsistent results with those reported by Bradley et al. (2001), and suggest that males did not show strong couplings for positive images. One contributing factor may again relate to the absence of erotica images, which in the IAPS is suspect of resulting in stronger couplings of pleasure and arousal in males

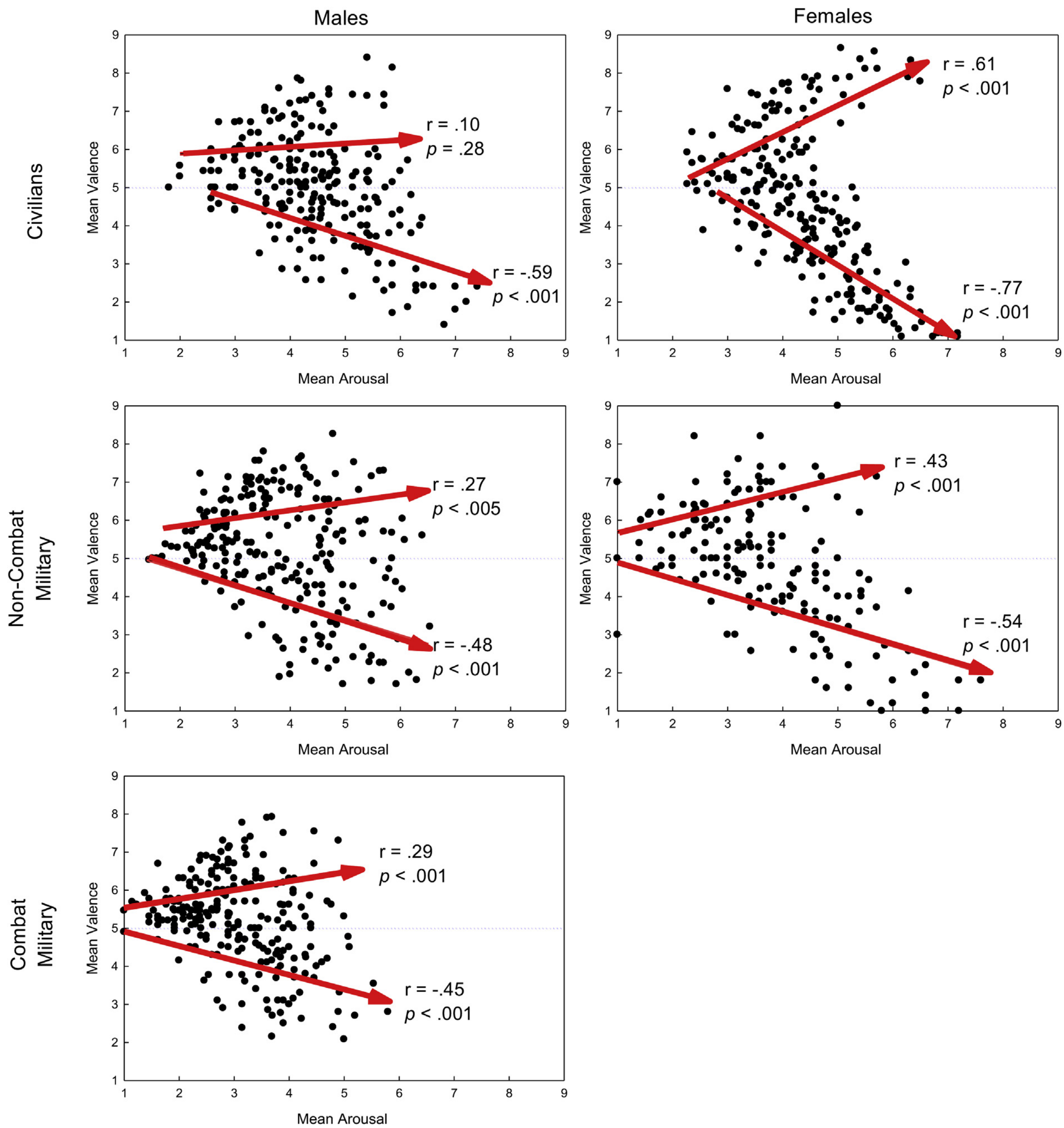

Fig. 5. Affective Space. Mean ratings of valence and arousal, for all 240 MAPS images by each group, with least squares linear regression functions plotted for pleasant (M > 5.00) and unpleasant (M < 5.00) images. Male ratings appear in the left column and female ratings appear in the right column. Results of the regression analyses are reported adjacent to each function. MAPS images with mean valence ratings equal to 5.00 appear in the figure, however, were excluded in regression analyses as neither pleasant nor unpleasant images.

compared to females. Similarly, this factor may explain selective discrepancy of pleasant MAPS and IAPS images. Another striking difference between MAPS ratings and IAPS reports is the significantly lower couplings observed for non-combat exposed military females and civilian females when viewing MAPS images. Like Bradley et al. (2001), civilian females showed significantly stronger couplings than any group for unpleasant MAPS images. Military females, however, demonstrated decreased defensive motivation to negative MAPS images, which never significantly differed from the couplings obtained across each of the male groups.

One interpretation of the current study's findings is that differences between military men and women are smaller in military populations than civilian populations when viewing MAPS images. However, given the somewhat small samples sizes of non-combat females and civilian males obtained, this differential effect of gender is not without limitations. Despite this limitation, Doherty, Orimoto, Singelis, Hatfeild, and Hebb, (1995) reported similar differential gender effects between college undergraduates and U.S. Marine Corp service members when measuring emotional contagions, or the tendency to converge emotionally with those around them. The authors posited that it would be difficult to rule out selection bias resulting from selective traits for the different professions or the effects of occupational exposure. Regardless of the explanation, the findings from both Doherty et al. (1995) and the current study suggest a unique effect of gender in affective responses in civilian populations.

4.3. Combat exposure

For the dimension of valence, the results revealed that pleasantness ratings mostly did not differ for civilians and soldiers, whether or not they had been exposed to combat. Exceptions for the equivalent pleasantness among groups were observed for civilians and non-combat exposed military when viewing the pleasant and arousing image category, with civilians reporting slightly lower pleasantness. The difference in non-combat exposed and combat exposed military samples in reported pleasantness of the unpleasant and unarousing image category suggests that exposure to combat environments did influence how unpleasant or pleasant soldiers reported responding to the unpleasant and arousing MAPS category.

Unlike valence ratings, there were significant differences between all three groups for arousal. Civilians had the highest ratings in arousal, followed by non-combat exposed soldiers, and then combat exposed Soldiers. This graded affect across groups suggests that soldiers with combat experience become somewhat desensitized due to exposure to stimuli in a deployed environment. Although an inversed and similar graded effect across groups was observed for the dimension of dominance, this group effect was attenuated when comparisons were controlled for age. Because combat exposure was determined via binary responses regarding deployment to combat zones, it is likely that as exposure to military events increases (e.g., deployments, operational training), it is possible that the older subjects were deployed more than once and consequently exposed to additional combat experiences. In future studies, it will be interesting to examine whether the number of deployments affects MAPS rating dimensions selectively.

Although significant correlations of mean valence and arousal ratings were observed for positive images regardless of combat exposure in military males, civilian males did not show a significant relationship. Despite these qualitative differences in appetitive motivation across the male groups, these correlations were determined not to differ statistically. Adding to these findings, there were differences in arousal ratings observed in combat exposed military males as compared to other male samples, irrespective of military status, for both positive and negative valence images, which suggests contextual exposure impacts emotional arousal. This finding suggests combat exposure has a general effect on arousal for both positive and negative military scenes.

4.3.1. Limitations

Given that both the military and civilian samples predominantly reported their ethnicity as "white", it remains unclear whether the normative ratings generalize to populations from alternate ethnic backgrounds. Additionally, gender was not equally represented among military and civilian samples. Given the obtained proportions for the current study's samples, any comparisons made to these groups should take particular sample size for respective normative ratings into consideration. Possibly, the most important limitation to the topic of gender is examining the reported affective responses to MAPS images in a sufficient sample size of combat exposed military females. Given the limited power achieved in the current studies' gender comparisons; it would be difficult to draw major conclusions regarding the interaction of combat exposure or military status with gender for each of the categories. Second, without having included the IAPS ratings to compare with the MAPS it is difficult to conclude whether any gender differences, or lack thereof, were due to a general effect or if they pertain only to viewing MAPS images, or if there was unintentional selection bias. Third, because the MAPS content pertains primarily to U.S. military operations, it is unclear if the normative ratings would generalize to other military and civilian populations. Fourth, it is possible that participant's completion of respective PCL questions prior to ratings of MAPS images may have influenced these norms, yet effects of such demand characteristics were not assessed in the current study. Finally, in assessing the effects of combat exposure and military status for male ratings, the current studies' samples are not equivalent to sample sizes reported for other affective image sets. Additional ratings would provide better assessments for these effects in both males and females. Despite these limitations, the current study is an important first step to understand the utility of military-relevant pictures in emotion research for military populations.

4.4. Future directions

Given that PTSD has been associated with changes in arousal, control, and processing (Newport & Nemeroff, 2003) there have been assertions that abnormal affective reactions associated with these and other pathologies are context specific (Amdur et al., 2000; Wolf et al., 2009). The finding that the MAPS shows sensitivity in SAM ratings based on military experience and combat exposure strongly points to this image databases' potential to elicit abnormal affective responses in combat-related conditions such as PTSD, if the PTSD is combat-related. As such, the MAPS can be applied to a variety of experimental paradigms to improve understanding of psychopathology in clinical and healthy military populations. For example, MAPS images can be utilized in adaptions of experimental paradigms used to study emotion-relevant pathological differences in such domains as visual attention (dot-probe task; MacLeod, Mathews, & Tata, 1986; Bryant & Harvey, 1997), top-down control of emotion (emotion regulation task; Johnstone et al., 2007), and empathy (emotional responding task; de Sousa et al., 2010). In addition, these procedures can be adapted to study clinical and healthy military populations using functional neuroimaging techniques to further explore the pathophysiological mechanisms of emotion-related disorders. Overall, the current study's findings suggest that the MAPS is an appropriate research instrument for eliciting context-dependent emotional responses. The MAPS is freely available for research to non-profit groups upon request (http://www.cla.auburn.edu/psychology/military-affective-picture-system/).

5. Disclaimer

The opinions, interpretations, conclusions, and recommendations are those of the authors and are not necessarily endorsed by the U.S. Army and/or the U.S. Department of Defense. The MAPS image database is not intended for private or commercial use; however it is freely available to the scientific researchers upon request.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jbtep.2015.07.006.

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