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Effects of resilience training on mental, emotional, and physical stress outcomes in military officer cadets

Regula Zueger[a], Madlaina Niederhauser[a], Chantal Utzinger[a], Hubert Annen[a], and Ulrike Ehlert[b]

[a]Department of Military Psychology and Military Pedagogy Studies, Military Academy at ETH Zurich, Birmensdorf, Switzerland; [b]Clinical Psychology and Psychotherapy, University of Zurich, Zurich, Switzerland

ABSTRACT
Resilience is an important factor in counteracting the harmful effects of stress and is associated with healthy physiological and psychological responses to stress. Previous research has demonstrated the effectiveness of resilience fostering training programs in psychobiological stress response and recovery. Few studies, however, have examined training effects in real-life high-stress situations. In this study, we compare effects of a brief resilience training (RT) and an active control training in diversity management (DMT) on psychobiological stress response to and recovery from an intense military exercise of 81 male officer cadets. Five weeks after training completion, autonomic, endocrine, and subjective state measures of cadets were measured while undergoing stressful military exercise. The RT group perceived the military stressor as more challenging, and showed higher values in motivation and positive affect than the DMT group. Cortisol increased in both groups during stress, but showed a lower cortisol increase in the RT group thereafter. These results suggest that this brief resilience training helped cadets reframe the stressful situation in a more positive light, experiencing more positive emotions, and recovering faster from stress. To strengthen young military leaders in stressful situations, resilience promoting programs should become part of basic or leadership trainings.

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Resilience training; high-stress situations; positive affect; stressor appraisal; cortisol

What is the public significance of this article?— The present study suggests that a brief resilience training may be helpful in managing acute high-stress situations and reducing negative stress-related consequences in young military personnel. This intervention may be embedded in the training of young leaders or managers who are most affected by occupational stress to improve their resilience and stress management skills.

Introduction

In the military, stress is often associated with deployment and its significant consequences such as post-traumatic stress disorder (Fulton et al., 2015). However, military members, even when not deployed, are exposed to a variety of stressors (Brooks & Greenberg, 2018) such as long working hours, high workload, demanding goals, and poor leadership. Non-deployment stress also negatively impacts emotional, mental, and physical health, and behavior and performance (Brooks & Greenberg, 2018; Hourani et al., 2006; Martins & Lopes, 2012). It is noticeable that young military personnel (< 25 years of age) are most affected by occupational stress and appear to have more mental health problems and productivity losses than older or higher-ranking personnel (Hourani et al., 2006). This is one reason why great weight should be given to the topic of stress in the training of young leaders (e.g., in officer training schools). Not least because they could be prone to unfavorable actions in their leadership activities, especially under stress, due to a lack of experience. As future leaders, they can become a major source of stress to their subordinates (Rajah et al., 2011) but can also buffer against work stressors (Schmidt et al., 2014). Furthermore, poor leadership as a source of stress can cause stress and burnout in subordinates (Harms et al., 2017). Leadership training therefore should address stress-related consequences on health and behavior, and train prospective leaders in managing stress and foster their resilience.

Resilience is an important factor that counteracts the harmful effects of stress on behavior, performance, and emotional, mental, and physical health (Shatté et al., 2017). Recently, resilience has been recognized as one of the potential outcomes of adversity, and is characterized by quick recovery or maintenance of mental health during and following exposure to adversity (Kalisch

CONTACT Hubert Annen hubert.annen@milak.ethz.ch Department of Military Psychology and Military Pedagogy Studies, Military Academy (MILAC) at ETH Zurich, Kaserne, CH – 8903, Birmensdorf, Switzerland.

et al., 2017). Resilient individuals demonstrate healthy physiological and psychological stress responses (Charney, 2004; McEwen et al., 1998). This includes an adaptive stress response, i.e., the ability to anticipate, respond to, and recover from stress (Johnson et al., 2014; McEwen et al., 1998). For instance, in military personnel, resilience was associated with faster cardiovascular recovery following acute laboratory stress (Souza et al., 2013). With respect to stress appraisal, resilient military personnel appraised traumatic stress as less threatening and more challenging. Further, they experienced more positive and less negative emotions during traumatic stress (Riolli et al., 2010). Regarding the continuing debate in resilience research, the present study considers resilience as the ability of an individual to deal successfully with challenging situations. The respective skills, such as cognitive reframing, emotion control, and energy management, can be trained and contribute largely to calm and solution-oriented action under stress.

Military organizations have implemented interventions and training programs to reduce the risk of negative stress-related outcomes and to promote mental health and resilience of their members (Castro et al., 2012; Cohn & Pakenham, 2008; Cornum et al., 2011; Crane et al., 2019; Lee et al., 2020; Niederhauser et al., 2022). Recent meta-analyses (Joyce et al., 2018; Vanhove et al., 2016) and a systematic review (Robertson et al., 2015) of research on the effectiveness of mental health training in several contexts, including the military, indicate promising results for a wide range of outcomes. Results demonstrate a significant positive impact on well-being from resilience-building programs in military settings (Vanhove et al., 2016). However, several military studies examined training effects only following deployments (Adler et al., 2009; Castro et al., 2012; Sharpley et al., 2008), surveyed mental health problems as an outcome (Adler et al., 2009; Castro et al., 2012), or failed to compare results with an active control group (Carr et al., 2013). Furthermore, only a few studies have examined the effectiveness of resilience training on psychophysiological response and recovery in real-life high-stress situations. For military and police, it is important that their members respond adequately to and recover quickly from acute highly stressful or dangerous situations. Accordingly, training effectiveness should be studied during real-life situations and realistic scenarios such as combat exercises (Jensen et al., 2020; Johnson et al., 2014) or critical police incident simulations (Andersen et al., 2016, 2015; Arnetz et al., 2009), which have been examined in only a few studies. Results from studies like these demonstrate positive training effects in endocrine (Andersen et al., 2016; Arnetz et al., 2009; Jensen et al., 2020), and cardiovascular stress response and recovery (Andersen et al., 2015; Johnson et al., 2014), as well as performance (Jensen et al., 2020; Johnson et al., 2014), mood, and stress perception (Arnetz et al., 2009). These findings highlight a preventive training effect prior to acute stress exposure and the association between resilience and positive adaption to stress and quick recovery after stress.

To summarize, research has shown that resilience training programs can improve psychobiological stress response and recovery as well as performance in high stress situations. Although resilience research shows differences in appraisal style and mood, prior intervention studies did not include stress appraisal (Andersen et al., 2015; Arnetz et al., 2009; Johnson et al., 2014) and assessed mood only after stress exposure (Arnetz et al., 2009). The current training evaluation addresses this gap in the literature.

In the present study, we aimed to test the effectiveness of a resilience training compared to control training in young military officer cadets. In particular, we examined if groups differed in their adaptation to stress during a highly physical and mentally challenging military exercise in the field. To obtain a comprehensive picture of training effects during a real-life high-stress situation, we assessed psychological and physiological correlates of resilience. We anticipated positive cognitive stress appraisal, less subjective stress and negative mood, and more positive affect for the resilience training group. Further, we expected rapid recovery of heart rate and an adaptive cortisol secretion during stress exposure.

Methods

Participants

Participants were 99 cadets (age 18–27 years, $M = 20.93$, $SD = 1.73$; 5 women, 94 men) of the Swiss Armed Forces infantry officer candidate school (Inf OS 1–10/17) in 2017. In Switzerland, military service is compulsory for men and admission to basic military training is based on passing a recruitment consisting of physical and psychological examinations. Admission to officers' school is voluntary and granted after completion of basic military training and noncommissioned officer (NCO) school including practical service, on recommendation of the military board and after positive psychological screening (i.e., in leadership motivation, self and social competences). Therefore, these cadets consisted of a representative sample of physical and mentally healthy young men and women. Due to sex differences in acute stress response (Kajantie & Phillips, 2006), only male cadets were included in study analysis. Over the course of the study, there were seven study dropouts (n = 3 voluntary study dropouts, n = 4 military attrition). Six cadets did not undergo the military stressor due to health reasons. The final sample consisted of 81 cadets participating in this military exercise.

Design and procedure

This controlled trial was part of a longitudinal research project on resilience in military cadre. In order to prevent cross-contamination (Cacioppo et al., 2015), cadets were randomly and class-wise assigned to either the resilience training or the diversity management training. At the beginning of the officer school (OS; week 1 of 15), cadets received detailed study information whereby both trainings were announced to promote skills for leaders to manage challenging social situations. After written informed consent was obtained, cadets completed demographic and psychometric questionnaires. All RT and DMT sessions were held during regular military training hours in week three, five, six, and seven of officers' school. Both trainings were facilitated by psychologists from the Military Academy (MILAC) at ETH Zurich who had been developing RT and DMT. Five weeks after the last training session, cadets' psychobiological stress responses were examined during a highly stressful military exercise (explained in detail below). Psychometric state measures (cognitive stress appraisal, affect, subjective stress, and motivation) and saliva samples were collected before and after stress exposure, and heart rate was recorded continuously. The study protocol was approved by the Ethics Committee Northwest and Central Switzerland (ID no. 2017–00841/ ClinicalTrials.gov Identifier: NCT03242837) and the institutional review board of the Armed Forces Personnel (J1).

Resilience training

RT was developed for healthy subjects and adapted for the needs of the Swiss Armed Forces to improve skills for managing stressful situations and build resilience to prevent negative stress outcomes (Niederhauser et al., 2022). The training is based on a cognitive behavioral approach and on positive psychology (Reivich et al., 2011). RT involved four sessions (4 x 90 minutes) with two different topics each (2 x 45 minutes), homework, and practices off training. Each topic included an initial psychoeducational introduction followed by single and moderated group exercises. Cadets worked in small groups of three with one advising coach. Group composition remained the same during all training sessions. Coaches had military and/or psychological backgrounds and were trained to support cadets individually and lead group exercises. Thus, RT employs a mixed-setting format of classroom-based delivery and coaching (Vanhove et al., 2016). The following topics were included in the training: (1) identifying stressful situations and contributing behaviors, (2) identifying and managing dysfunctional thoughts and misconceptions, (3) identifying core beliefs and values, (4) dealing with negative thoughts, (5) stress management, (6) energy management, (7) constructive communication skills, and (8) character strengths. For military everyday life, the awareness of individual patterns during challenges, cognitive reframing and alternative coping mechanisms serve to respond more appropriately in future situations. Cadets were therefore advised to constantly reflect on their patterns during the challenges in officers' school and to apply alternative coping strategies. During RT, their experiences were discussed in groups with their comrades and supported by the advising coach. Thus, topics 1 to 5 are designed to deepen their understanding of driving mechanisms of stress, to become mentally strong and to find positive ways of dealing with such challenges. In addition, energy management (6) is used to deal appropriately with one's own resources during but also after stress. In addition to the focus on mental strength or cognitive skills (1–5) and energy management (6) during stress, RT extends interpersonal skills and tools that future military officers may use during military everyday life (7–8). Techniques that focus on constructive communication with their subordinates may help to appropriately respond in stressful situations and to improve their relationship. Finally, targeting one's own strengths and the strengths of subordinates can help during military challenges to operate more efficiently and save energy. Overall, these training contents are designed to promote mental strength in difficult situations and to sensitize for a balanced energy level during and after challenges. Two additional exercises to promote optimism and positive emotions were conducted during the course of and at the end of the training, respectively. Despite high demands during officer school, cadets were advised to collect and reflect on positive moments. This was to help them experience more positive emotions and optimism even when faced with adversities and to reappraise future challenges.

Diversity management training

DMT was adapted from contents of the military leadership training and aimed to promote social skills in leading military personnel. The DMT group attended four weekly sessions of 90 minutes each in the classroom and was trained on topics of diversity management in civil and military everyday life. The following contents were provided: (1) stereotypes and prejudice, (2) multilingualism, (3) ethnicity and religion, (4) gender, and (5) teamwork and conflicts. Each session contained theoretical inputs followed by single and group exercises, and homework outside the training environment.

Military stressor

Toward the end of the OS (week 12 to 13), cadets completed an intense and extremely stressful week, the so-called perseverance week, where they were physically (e.g., sleep deprivation, nutritional restrictions) and mentally (e.g., performance pressure, limited privacy) pushed to their limits. They were exposed to several operational challenges and stressors of varying intensity and duration. One exercise was announced as particularly challenging (physically and mentally). First, cadets had to infiltrate an open area and had to avoid being caught by a fake enemy (two professional NCOs). Then they had to crawl through a tight sewer (1.5 km of length, 1.50 m of height), where they encountered water, insects, or other small animals. The exercise was performed fully equipped (e.g., loaded rucksack of ~20 kg, rifle) and in small groups. Given the high psychological and physical stress caused by this exercise, it was chosen to examine cadets' stress response. This field exercise can be viewed as a litmus test of the challenges the cadets have previously experienced and reflected upon and how resilient they are in the face of such adversity. More specifically, training contents targeting mental processes, cognitive reframing, optimism, and energy management which are associated with resilience can be studied. This military exercise was conducted on the second day of the perseverance week between 8:15 PM and 3:00 AM. Due to restrictive rules during this perseverance week, cadets were not allowed to drink coffee nor consume alcohol or nicotine. Further, there was no food intake for a minimum of 2 hours before the exercise.

Measures

Socio-demographic data

Sociodemographic variables (age, education, smoking status) were assessed after signing consent (week 1), and anthropometrical data (weight and height) were collected by the military board during the first week of training.

Cognitive stress appraisal

Cognitive stress appraisal was assessed before the military exercise (pre) using two subscales *challenge* (α = 0.69) and *threat* (α = 0.73) of the Primary Appraisal and Secondary Appraisal Questionnaire (PASA; Gaab, 2009). PASA contains 16 items on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). Items listed in the PASA scale measuring the subscale *challenge* include, for example, "The situation is challenging me." or "The situation is important/relevant to me." The subscale *threat* includes sample items such as "I do not feel threatened by the situation" or "The situation makes me very uncomfortable."

Stress and motivation

Subjective stress and motivation were assessed with visual analogue scales (VAS; Aitken, 1969; Hasson & Arnetz, 2005) before (pre) and after (post) the military exercise. Cadets had to indicate their stress ("How stressed are you feeling at the moment?") and motivation ("How motivated are you feeling at the moment?") levels on a horizontal line of 10 cm ranging from zero (not at all) to 100 (maximum).

Positive and negative affect

Affect state was examined before (pre) and after (post) the military exercise with the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). Both positive (PA) and negative (NA) scales consist of 10 items and were answered on a 5-point Likert scale (1 = very slightly or not at all to 5 = extremely). Some items listed in the PA scale include "Please indicate how active/determined/interested/pleased/strong/enthusiastic you are feeling at the moment." Sample items in the NA scale include "Please indicate how upset/irritated/hostile/ashamed/nervous/anxious you are feeling at the moment." Internal consistency reliability was very good for both affect scales (Cronbach's α: PA pre = 0.91, PA post = 0.90; NA pre = 0.86, NA post = 0.85).

Cortisol

Three saliva samples of 2 mL were collected for cortisol: before (pre) the exercise, shortly after (post) and 20 minutes after (+20' post) the exercise ended. Saliva samples were obtained using tubes (SaliCaps, IBL International GmbH, Hamburg, Germany) and stored at −20°C before analysis. Cortisol was analyzed at the biochemical laboratory of the Institute of Psychology of the University of Zurich using Luminescence Immunoassay (LIA, IBL International GmbH, Germany). Inter- and intra-assay coefficients variation were below 5%.

Heart rate

Heart data was recorded continuously using a small, lightweight monitoring device (Actiheart 4, CamNtech, Cambridge, UK). Data processing and analysis was made in Kubios HRV Premium software version 3.1. Data was split into the following phases: preparation (pre-stress, 2 minutes), infiltration, tunnel stress, recovery (10 minutes), and rest (10 minutes). For infiltration and tunnel stress, an individual mean HR score was obtained by calculating a mean for the time range of HR data from the start until the completion of each phase.

Statistical analysis

Data analysis was performed using the statistical program R version 3.5.3 for Macintosh. To test statistical significance of hypotheses, an alpha level of .05 was set for all analyses. To investigate differences between groups, we applied independent Welch's *t*-test for continuous variables and chi-squared test for frequency analyses. Outliers (> ± 3 standard deviation from the mean) were found in psychometric data (one outlier in stress pre and post; two outliers in negative affect pre and post) and winsorized prior to all analyses.

Mixed effects models were applied to account for non-independency in repeated measures. Analyses were conducted using the lme4 package. The lmerTest package was used to estimate the corresponding *p* values based on Satterthwaite's approximation for the degrees of freedom. Fixed effects of time (pre- to post-stress) and group (RT vs. DMT) were modeled in a random intercept model. The intercept of each cadet was modeled using a random intercept. Mixed effect models were applied to determine whether subjective stress, motivation, positive affect, negative affect, cortisol, and heart rate differed between groups and over time and whether a time by group interaction was observed. For each model with cortisol and heart rate, theoretically relevant variables (age, body mass index/BMI, height) or differing variables between groups (duration in tunnel) were included as potential confounders. All continuous covariates and predictors were standardized for ease of interpretation. Cortisol concentrations, negative affect, and stress were log-transformed to remedy skewness of the distributions. A likelihood ratio test was used to reveal whether including group as a main effect or in interaction with time was necessary. To verify the robustness of the findings, we compared our outcomes to the results of corresponding robust methods; a robust variant of the t-test using the WRS2 package and a robust variant of mixed effects models using the robustlmm package.

Results

Sample characteristics

As shown in Table 1, groups did not differ with regard to their body mass index (BMI), height, weight, smoking, or education, but there was a difference in age ($p < .01$). The duration of the infiltration phase was on average 17.15 minutes (*SD* 4.44) and did not differ between groups ($p > .05$). Tunnel exercise lasted on average 41.41 minutes (*SD* 11.80) and groups showed a significant difference in duration ($p < .05$). Due to waiting times in tunnel, some cadets from both groups ($n_{RT} = 5$; $n_{DMT} = 7$) showed longer tunnel stress duration ($M = 61.17$, $SD = 15.32$). The waiting cadets ($M = 137.49$, $SD = 15.32$) did not differ in their average heart rate ($p > .05$), from the non-waiting cadets ($M = 142.05$, $SD = 14.88$).

Due to some restrictions on stressor duration and time window provided by the military exercise command, some cadets did not manage to provide all three saliva samples (resulting in: $n_{RT} = 32$, $n_{DMT} = 36$). In addition, heart data with poor recording quality or high artifact rates were not analyzed (resulting in: $n_{RT} = 31$, $n_{DMT} = 32$).

Cognitive stress appraisal

On average (see, Table 2), the DMT group showed lower values in the subscale *challenge* than the RT group,

Table 1. Sample characteristics of study groups.

	Resilience Training Group (n = 35) M (SD)	Diversity Management Training Group (n = 46) M (SD)	Statistics	
			t/Chi^2	p
Age (years)	20.3 (1.3)	21.2 (1.5)	2.74	**.008**
BMI (kg/m^2)	23.4 (2.3)	23.9 (2.2)	0.94	.350
Height (cm)	179.0 (6.0)	177.2 (7.1)	−1.18	.241
Weight (kg)	75.1 (8.9)	74.9 (8.3)	−0.04	.969
Smoker	8.6%	26.1%	2.96	.085
Education	100%	93.5%	0.89	.344
Upper secondary school level	0%	6.5%		
Tertiary level				
Duration Infiltration (in minutes)	16.9 (5.5)	17.4 (3.2)	0.23	.821
Duration Tunnel (in minutes)	41.3 (14.2)	41.6 (9.2)	2.22	**.033**

Percentages in bold indicate significance level $p < .05$.

Table 2. Descriptive data of questionnaire means by group.

	Resilience Training Group (n = 35)		Diversity Management Training Group (n = 46)	
	Pre	Post	Pre	Post
Challenge (PASA subscale)	4.6 (0.8)		3.7 (1.0)	
Threat (PASA subscale)	2.9 (1.0)		3.0 (1.1)	
Subjective Stress (VAS)	35.7 (25.4)	18.1 (20.3)	25.1 (24.3)	12.7 (18.3)
Motivation (VAS)	54.4 (23.6)	76.1 (21.2)	38.1 (29.9)	50.8 (31.8)
Positive Affect	28.9 (7.9)	36.7 (7.4)	26.2 (8.0)	30.1 (8.6)
Negative Affect	17.1 (6.4)	13.0 (4.2)	17.2 (6.4)	14.5 (5.3)

Standard deviations are shown in parentheses.

−0.92, 95% CI [−1.343, −0.502]. This difference was significant, $t(79) = -4.364$, $p < .001$, and represented a large effect size, $d = -0.979$. The other subscale *threat* did not show group differences ($p > .05$).

Subjective stress and motivation

Results of the mixed effects model revealed a non-significant time and group interaction in subjective stress, $ß = -0.317$, $SE = 0.416$, 95% CI [−1.131, 0.496], $t(79) = -0.763$, $p = .448$. Subjective stress decreased significantly from pre to post stressor, $ß = -0.768$, $SE = 0.273$, 95% CI [−1.303, −0.232], $t(79) = -2.811$, $p = .006$. In motivation, analyses revealed no significant interaction of time and group, $ß = 9.034$, $SE = 6.176$, 95% CI [−3.064, 21.131], $t(79) = 1.463$, $p = .148$. Motivation increased significantly from pre to post stressor, $ß = 12.652$, $SE = 4.060$, 95% CI [4.699, 20.604], $t(79) = 3.116$, $p = .003$. Results indicated that the RT group showed significantly higher motivation before the military stressor (see, Table 2), $ß = 16.270$, $SE = 6.179$, 95% CI [4.220, 28.319], $t(126.357) = 2.633$, $p = .010$.

Positive and negative affect

Results of the mixed effects model (see, Table 3) revealed a significant interaction of time and group in positive affect, $ß = 3.959$, $SE = 1.943$, 95% CI [0.152, 7.765], $t(79) = 2.037$, $p = .045$, $d = 0.77$, indicating a greater increase over time in the RT group (see, Figure 1). Positive affect increased significantly from pre to post stressor, $ß = 3.870$, $SE = 1.277$, 95% CI [1.367, 6.371], $t(79) = 3.029$, $p = .003$. Negative affect did show a non-significant interaction of time and group, $ß = -0.136$, $SE = 0.070$, 95% CI [−0.276, 0.000], $t(79) = -1.973$, $p = .052$, $d = -0.61$. The decrease of negative affect was significant from pre to post stressor, $ß = -0.162$, $SE = 0.045$, 95% CI [−0.251, −0.076], $t(79) = -3.590$, $p = .001$.

Salivary cortisol

To check the possible influence of starting time on cortisol, pre-stress levels were compared using t-tests and revealed no significant differences ($p > .05$) between groups. To estimate change over time from pre to post stress between groups, the model used time as a categorial predictor. Results on log transformed cortisol revealed that, after controlling for age, BMI, and duration in tunnel, a significant effect of time was observed immediately post, $ß = 1.630$, $SE = 0.150$, $t(145.794) = 10.836$, 95% *CI* [1.336, 1.922], $p < .001$, and 20 minutes post stress, $ß = 2.004$, $SE = 0.161$, $t(150.105) = 12.435$, 95% *CI* [1.688, 2.315], $p < .001$. These results indicate an increase of cortisol over time. Results revealed a non-significant effect of group, $ß = 0.408$, $SE = 0.221$, $t(150.177) = 1.844$, 95% *CI* [−0.408,

Table 3. Group x time interactions from mixed effects models.

	b (SE)	*t* (df)	95% CI	p-value
Stress (VAS)	−0.32 (0.42)	−0.76 (79)	−1.13, 0.50	.448
Motivation (VAS)	9.03 (6.18)	1.46 (79)	−3.06, 21.13	.148
Positive Affect	3.96 (1.94)	2.04 (79)	0.15, 7.77	**.045**
Negative Affect	−0.14 (0.10)	−1.97 (79)	−0.28, 0.00	.052
Cortisol	−0.32 (0.23)	−1.38 (145.99)	−0.76, 0.13	.169
Immediate post stress	-0.60 (0.24)	-2.54 (148.41)	−1.06, −0.14	**.012**
20 minutes post stress				
Heart Rate	4.68 (3.46)	1.35 (233.63)	−2.02, 11.37	0.178
Infiltration	5.83 (3.46)	1.68 (233.63)	−0.87, 12.52	0.094
Tunnel Stress	2.90 (3.48)	0.83 (233.96)	−3.82, 9.64	0.406
Recovery	0.55 (3.63)	0.15 (235.67)	−6.44, 7.61	0.880
Rest				

Percentages in bold indicate significance level $p < .05$.

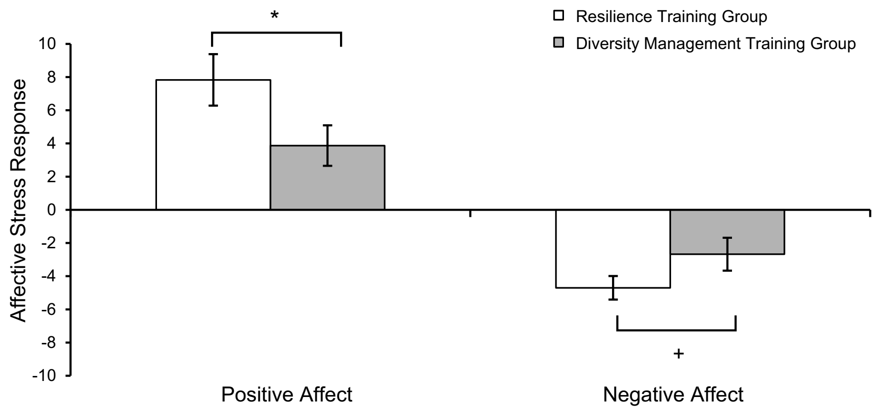

Figure 1. Positive and negative affect of study groups before and after military stressor. Bars and error bars represent means ± standard errors of delta values between pre and post stress.; *p < .05, + p < .10.

0.833], $p = .067$. Results revealed a significant interaction of time and group observed 20 minutes post stress, $ß = -0.599$, $SE = 0.236$, $t(148.408) = -2.537$, 95% *CI* [−1.056, −0.138], $p = .012$, $d = -0.9$ (see, Table 3). These results indicate that the DMT group showed a higher increase of cortisol 20 minutes post stress compared to the RT group (see, Figure 2).

Heart rate

Results of the mixed effects model including time as categorial predictor revealed significant effects of time (see, Figure 3). Pairwise comparison revealed an increase of heart rate during infiltration $ß = 40.81$, $SE = 1.73$, $t(238) = 23.576$, $p < .001$, and tunnel $ß = 69.27$, $SE = 1.73$, $t(238) = 40.013$, $p < .001$, and a decrease of heart rate during recovery, $ß = -27.08$, $SE = 1.74$, $t(238) = -15.565$, $p < .001$, and rest, $ß = -25.68$, $SE = 1.82$, $t(-14.104) = 6.357$, $p < .001$. Results revealed no significant effect of group ($p > .05$) and no interaction effect of group and time (p's > .05; see, Table 3).

Discussion

In this study, we investigated whether young prospective military leaders benefit mentally or physically from

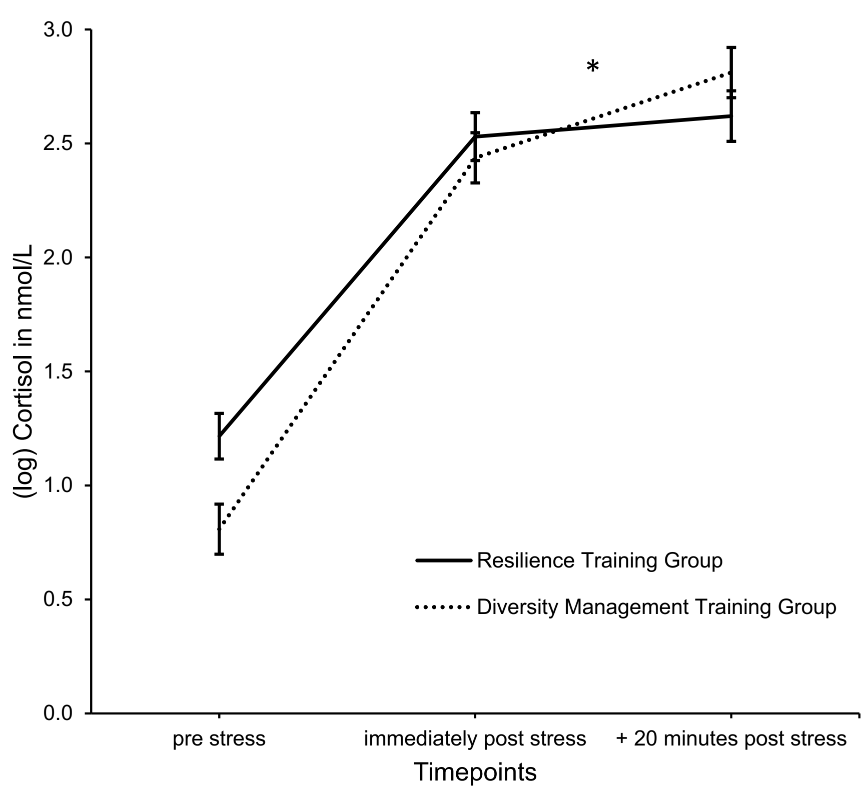

Figure 2. Expected log cortisol of study groups during military stressor.

Figure 3. Heart rate of study groups during military stressor.

a short resilience training during acute high stress. As hypothesized, results show that the RT group appraised a highly stressful military exercise as more challenging and experienced more positive emotions despite the situational demands, compared to the DMT group. Moreover, the RT group reported higher motivation prior to the exercise than the DMT group. While the cortisol levels of both groups did not differ before and immediately after exercise, the RT group showed lower cortisol secretion 20 minutes after exercise. No differences were found between groups in subjective stress, negative affect, and autonomous stress response.

The present study corroborates and extends previous research (Castro et al., 2012; Cohn & Pakenham, 2008; Cornum et al., 2011; Crane et al., 2019; Lee et al., 2020; Niederhauser et al., 2022) by showing that resilience training positively affects cognitive stressor appraisal and emotional state during high-stress situations. While negative emotions narrow the thought-action scope (Fredrickson, 2002) in stressful situations, positive emotions support psychological adjustment (Riolli et al., 2010), broaden intentional focus and behaviors, and thus build resources (Fredrickson, 2002) and protect against harmful effects of stress (Fredrickson & Joiner, 2002). At the beginning of a leadership career, young officers are exposed to a variety of new stressors. Therefore, the ability to appraise stressful situations as challenge can help a person to learn and grow from them. In addition, if they experience more positive emotions during stress, they may use and expand their leadership behaviors, and also adapt more easily. Moreover, as a leader, they have considerable influence on how their subordinates appraise such situations (Bartone, 2006). Therefore, a motivating, optimistic, and positive attitude of leaders may help their subordinates look ahead optimistically and build and use their own resources in coping with the situation.

The group differences in cortisol secretion confirm positive training effects during high stress. Similarly to Jensen and colleagues (Jensen et al., 2020), cadets of both groups showed significant cortisol increase in response to the military exercise. However, 20 minutes after the exercise, the RT group showed lower cortisol secretion than the DMT group. These results demonstrate that this stressor was of high physical and psychological intensity. Furthermore, results suggest that resilience training might help cadets to adapt and recover more quickly from such stressful military exercises.

In contrast to previous studies (Arnetz et al., 2009; Johnson et al., 2014), the present investigation did not find group differences in heart rate during stress and recovery. In both groups, heart rate increased significantly during exercise, with the highest values while in the tunnel and a decreasing heart rate during recovery and rest. Similar to other research (Johnson et al., 2014), HR pre-stress levels of both groups have not been reached even after 20 minutes upon stressor termination. Specific breathing and mindfulness-based intervention techniques applied during physical stress may directly control the activation of the autonomous nervous system and improve cardiovascular recovery. However, a single breathing exercise did not help cadets in the RT regulate their autonomic stress response, as has been shown in other studies (Arnetz et al., 2009; Johnson et al., 2014).

Despite the encouraging findings, there are some study limitations to be reported. First, saliva sampling was restricted by the military procedure and time constraints. In both groups, cortisol was still increasing at 20 minutes of recovery and may have been even higher at a later recovery time point. Following high physical intensity, cortisol peak may not be reached until after 30 minutes (VanBruggen et al., 2011). Therefore, to account for possible group differences in cortisol recovery, more saliva samples would have been required. Second, cortisol output or change determined by the widely applied formula area under the curve (AUC; Pruessner et al., 2003) could not be applied due to individual time differences between the first and second saliva samples. Third, while investigating psychobiological response to a realistic high-stress situation increases external validity, unknown and therefore uncontrollable confounding factors are present in such field exposures and therefore may decrease internal validity. Fourth, only male cadets were included in the analyses, which minimizes generalizability. Fifth, larger sample sizes and a replication of the study might yield more robust effects. Finally, training effects on leadership behaviors during high stress were not obtained, although the RT was also developed to minimize unfavorable leadership behavior under stress. It is possible that young platoon leaders with resilience training exhibit more favorable leadership behaviors in stressful situations and are therefore not considered as stressors for subordinates.

Conclusions

Young cadets are exposed to a variety of stressors with varying intensity and are therefore at risk of stress-related disorders. Results from this study provided support for the use of resilience promoting programs during officers' school, designed to help cadets effectively respond to and recover from highly stressful situations. Resilience training helped cadets in reframing the stressful situation in a more positive light and experiencing more positive emotions overall. The lower cortisol secretion during recovery also suggests that resilience training may help the cadets to adapt and recover from stress. As health, performance, and economic costs of stress-related disorders are immense, resilience promoting programs should become part of basic and leadership trainings to strengthen mental forces and improve leadership behavior in critical situations.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

The data that support the findings of this study are available on request from the author.

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