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Evaluation and Validation of a Stress Management Training Course for Air Traffic Control Trainees

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16. Abstract Evidence suggests that air traffic control (ATC) trainees find training at the FAA Academy to be stressful due to the fast pace of instruction, difficult performance evaluations, and pass rate. Given that stress may be a contributing factor to some trainees being unable to pass FAA Academy training, a stress management training course was developed to assist trainees in managing their stress. The objectives of this training course are to (a) improve trainee knowledge of stress and stress management concepts and (b) provide trainees stress management techniques for managing their stress while at the FAA Academy. The stress management training is based on psychological research and provides information on stress, stressors, consequences of stress, and stress management techniques. The effectiveness of the stress management training was assessed with 118 En Route and Terminal trainees enrolled in Initial Qualification training at the FAA Academy. We found that the stress management training was associated with gains in objective and perceived stress management knowledge and that these gains were maintained over one to two months. Additionally, the training was associated with gains in stress management confidence immediately following the training as well as reported changes in the use of stress management techniques. ATC trainees found the stress management training to be an effective use of their time, informative, engaging, and important to their success at the FAA Academy. The implications of these findings for the ATC training process and trainees at the FAA Academy are discussed.					
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List of Acronyms

ATC	Air Traffic Control
CAMI	Civil Aerospace Medical Institute
FAA	Federal Aviation Administration
NAS	National Airspace System
NASA	National Aeronautics and Space Administration

Introduction

Air traffic control (ATC) is a demanding occupation that is responsible for the safe and orderly flow of air traffic in the National Airspace System (NAS). As a safety-critical profession, air traffic controllers, or simply controllers, must maintain a high standard of performance when completing complex tasks such as air traffic sequencing, aircraft conflict resolutions, and maintaining situation awareness of their airspace. Controllers must reliably perform these duties under conditions of high traffic, time pressure, and poor weather. Combined with the potential for critical incidents, ATC has earned a reputation as a high stress occupation (Costa, 1995).

In order to ensure that controllers are well-trained and capable of controlling air traffic, the Federal Aviation Administration (FAA) requires all controllers go through a multi-stage training process¹. Controller training begins at the FAA Academy, which determines if an individual will advance to field qualification training at a field facility. The first stage of training lasts three to four months and teaches ATC trainees the foundational principles and skills of ATC. The FAA Academy is a high-stakes training program because failure to demonstrate sufficient proficiency on classroom tests and simulation exercises results in termination from the position. At present, pass rates at the FAA Academy fluctuate around 70%, but have been as low as 50% in recent years (Pierce, 2017). The significant consequences associated with FAA Academy training suggest learning to control air traffic may also be a stressful experience.

Research on factors contributing to success at the FAA Academy by the FAA's Civil Aerospace Medical Institute (CAMI) highlights that effectively managing stress may be a determinant of whether an ATC trainee passes or fails training. Pierce, Buck, and Barrett (2018) found ATC trainees who successfully passed FAA Academy training reported that stress management was important to success in training. A follow-up study by Barrett, et al. (2018) corroborated the idea that training is stressful for ATC trainees and that stress management is important for success. Barrett et al. (2018) found that successful ATC trainees rated the FAA Academy training process as a stressful experience and reported their classmates as finding the training experience to be equally stressful as well. Key stressors cited by these trainees included

¹ New hires with at least 52 weeks of prior air traffic control experience at a civilian or military facility are allowed to skip training at the FAA Academy and are assigned directly to a facility for field qualification training (Federal Aviation Administration, 2019). These individuals did not participate in this research effort as they do not attend the FAA Academy.

the performance evaluations, pass rate, and potential for job loss as a result of failure in training. These findings suggested the need for additional resources for assisting ATC trainees in managing their stress at the FAA Academy to lessen the potential negative effects of stress on training performance.

A common approach to addressing occupational stress is through stress management training. These interventions aim to provide employees with the knowledge and skills, including stress management techniques and coping strategies, needed to reduce sources of stress and/or the experience of stress itself (Holman, Johnson, & O'Connor, 2018). Example types of stress management training include cognitive-behavioral interventions (e.g., Bond & Bunce, 2000), relaxation-based interventions (e.g., Shapiro et al., 2005), journaling interventions (e.g., Alford, Malouff, & Osland, 2005), and interventions that combine multiple techniques (e.g., Pruitt, 1992). Generally, these training programs demonstrate medium-to-large effects in reducing stress and improving psychological outcomes (e.g., lower anxiety; Richardson & Rothstein, 2008), making them an evidence-based approach for mitigating employee stress.

To assist ATC trainees in addressing and mitigating the effects of stress while at the FAA Academy, a stress management training was developed. The stress management training was adapted from a training created for astronaut candidates by the National Aeronautics and Space Administration (NASA; 2017) and modified for use in the controller occupation. The ATC stress management training included information on the physiological, psychological, and behavioral effects of stress in humans, as well as stress management techniques for mitigating stress responses. The main objectives of the training course were twofold: to improve trainee knowledge of stress management concepts and to provide trainees with stress management techniques for managing their stress at the FAA Academy. To determine if the stress management training met these objectives, we examined the effectiveness of this training in terms of subjective learning and behavioral outcomes and objective knowledge outcomes. We also evaluated trainees' perceptions of the utility and usefulness of the training course.

FAA Academy Training

Newly hired ATC trainees with less than 52 weeks of prior controller experience are required to undergo three to four months of training at the FAA Academy located in Oklahoma City, OK. Before arriving at the FAA Academy, ATC trainees are assigned to a controller

option: En Route or Terminal². This option assignment determines an individual's training track, ATC position, and the type of facility that the trainee will be placed following the successful completion of Academy training. Trainees must pass FAA Academy training to advance to a field facility for site-specific, on-the-job training (FAA, 2019), and failure to pass the Academy results in termination from the controller occupation at the FAA.

FAA Academy training begins with the Air Traffic Basics course. The Basics course is five weeks in length and uses classroom instruction to teach the fundamentals of ATC including basic flight principles, basic ATC principles and concepts, and an introduction to ATC standard operating procedures. After Basics, ATC trainees take an option-specific Initial Qualification course consisting of classroom instruction, team exercises, computer-based instruction, and simulation exercises (FAA, 2019). The Initial Qualification course is 37 to 57 days depending on the controller option. Starting in 2011, the FAA Academy implemented cumulative grading to evaluate trainee performance. Prior to this change, FAA Academy success was determined by performance on a simulation assessment (Reese & Heil, 1999). Changes to the grading system were made in response to an impending hiring increase as well as external questions about the efficacy of the ATC training process (U.S. Department of Transportation Office of the Inspector General, 2004, 2008). The cumulative grading used in the Initial Qualification training combines scores from classroom knowledge tests and simulation exercises into a composite score with scores received during simulation exercises being more heavily weighted in the final calculation. Seventy out of a possible 100 points are needed to pass the FAA Academy. The introduction of these changes led to a sizable, but expected, decrease in FAA Academy pass rates with hopes of producing well-prepared trainees for the field.

These curriculum changes likely added to the already stressful nature of learning to control air traffic. When Pierce et al. (2018) asked successful ATC trainees at the FAA Academy to provide advice to future trainees, many reported that effectively managing stress during training was critical to their success, especially as training progressed to the end-of-course assessments. Similarly, Barrett et al. (2018) surveyed 40 successful ATC trainees about their perceptions of stress at the FAA Academy. The majority of trainees who were surveyed reported

² The Terminal option includes training for Air Traffic Control Tower and Terminal Radar Approach Control facilities. The title of the terminal initial course is Initial Tower Cab Training. For the purposes of this report, the use of Terminal and Tower Cab are synonymous.

that the training process was stressful. The survey respondents' mean rating was 5.40 on a 7-point Likert scale that asked trainees about the extent to which the FAA Academy training experience was stressful. Successful trainees also reported that their classmates as experiencing similar levels of stress during training ($M = 5.93$; Barrett et al., 2018). ATC trainees identified several stressors, or sources of stress, that they experienced during the training process. The most frequently mentioned stressors were performance evaluations, the potential for job loss, the fast pace of instruction, and the training pass rate (Barrett et al., 2018). Other notable stressors included watching classmates fail, the amount of information to be learned during training, and uncertainty about facility placement after training.

Stress

Stress occurs when a person perceives the demands of environmental stimuli to be greater than their ability to meet, mitigate, or alter those demands (Lazarus et al., 1985). This discrepancy is especially impactful when the task may affect one's comfort and security (Lazarus & Folkman, 1984). Given prior research on the consequences of stress, stress may act as a barrier to some trainees learning ATC knowledge and skills during FAA Academy training. The demands of FAA Academy training, such as the pressure to perform and the fast pace of instruction, are viewed as stressful aspects of the training process (Barrett et al., 2018). Additional career-related stressors such as relocation, schedule changes between day and night shifts, and interpersonal relationships with classmates and instructors may contribute to stress as well, even though they are not directly related to learning the job. Exposure to these short-term and long-term stressors can have physiological (e.g., increased heart rate; Vrijkotte, Van Doornen, & De Geus, 2000), behavioral (e.g., selective attention; Chajut & Algom, 2003), and psychological (e.g., negative mood; Sonnentag & Frese, 2003) impacts on training performance. It may not be the case that each trainee experiences all of these stressors; however, with the evidence collected by Barrett et al. (2018), we expect that ATC trainees likely experience stress in similar ways during FAA Academy training. Additionally, it is plausible that stressors experienced during training may be at a higher intensity than typical workplace stressors given the job jeopardy nature of the training program. Because of this, ATC trainees may benefit from additional resources or strategies for managing their stress responses.

Negative Consequences of Stress

Research on organizational stress consistently finds a relationship between increased stress and lower levels of well-being. Stressors such as job insecurity, workload, and relocation relate to increased psychosomatic complaints, fatigue, and feelings of distress (Garst, Frese, & Molenaar, 2000; Moyle & Parkes, 1999; Rydstedt, Johansson, & Evans, 1998). Schumacher et al. (2015) found that job insecurity was positively related to psychosomatic complaints such as headaches and dizziness, and that this relationship was partially due to the increased levels of emotional exhaustion that resulted from job insecurity. As failure at the FAA Academy results in termination of employment, it is probable that ATC trainees experience similar types of stress reactions. Research on stress in the ATC occupation has found that self-reported feelings of stress relate to lower levels of work satisfaction (Kavanagh et al., 1981).

Additionally, and perhaps most importantly, stress has the potential to influence individual performance (e.g., Gilboa et al., 2008; Motowidlo, Packard, & Manning, 1986). Research demonstrates that exposure to stressors can impair working memory capacity (Klein & Boals, 2001), sustained attention (Warm, Matthews, & Finomore, 2018), learning processes (Joëls et al., 2006), and overall performance (Glaser et al., 1999). For example, LePine, LePine, and Jackson (2004) found that stress was negatively related to learning performance when hindrance stressors such as unclear course expectations in the learning environment, as opposed to challenge stressors or course difficulty, caused stress. Stress and fatigue have been found to influence the performance-related behaviors of controllers (e.g., Della Rocco, 1999). Edwards et al. (2014) interviewed En Route controllers and identified that stress resulted in several performance-related issues, including incorrect instructions, falling behind on tasks, and communication problems due to speaking faster and speaking louder or quieter. All things considered, the various health and performance effects of stress may interfere with a trainee's ability to succeed in training.

Positive Consequences of Stress

Conversely, it is important to note that not all stress is bad. In fact, an appropriate level of stress can be motivating and beneficial for performance (LePine, LePine, & Jackson, 2004; Tafalla & Evans, 1997). According to the Yerkes-Dodson Law (Yerkes & Dodson, 1908), an optimal level of arousal or stress can enhance performance, but too much or too little stress may lead to performance decrements. Nevertheless, when an optimal level of arousal matches the individual's level of skill, a state of flow is likely to occur (Csikszentmihalyi, 1975). Flow involves an experience of intense focus that may include the feeling of being "in the zone". This suggests that an appropriate level of stress may be functional for ATC trainees if they are able to manage their stress effectively. Sonnentag and Frese (2003) argue that individuals can often overcome stressors if they possess the necessary strategies for coping with their environment. However, not all capable employees may have the stress management skills needed for dealing with job demands upon entry into the occupation. Therefore, providing ATC trainees with stress management may enable them to better manage the various stressors encountered at the FAA Academy and potentially improve their capacity to be successful in training.

Stress Management Training

While workplace stress cannot be eliminated completely, stress management training can reduce workplace stressors and assist employees in managing the negative outcomes of stress (Richardson & Rothstein, 2008). Ivancevich et al. (1990) developed a conceptual model of stress management interventions and described that these interventions can target three different components of the stress cycle: the intensity or number of stressors, the employee's appraisal of stressful situations, and the employee's ability to cope with stress. Interventions aimed at reducing the number of stressors employees face on the job include job design and selection practices. These practices focus on redesigning the job so that it is less stressful, or hiring individuals who are better able to handle stress (Ivancevich et al., 1990). Alternatively, interventions aimed at the latter two components of the stress cycle involve individual-level training interventions that focus on improving the knowledge and skills of employees dealing with stress (Ivancevich et al., 1990).

Individual-level interventions are the most frequently used form of stress management training within organizations (Holman et al., 2018). In general, the purpose of this type of training is to improve the way individuals view and understand stress, teach a broad set of strategies for coping with stress, and provide opportunities for practice (Sonnetag & Frese, 2003). Stress management interventions commonly emphasize stress management techniques such as relaxation, journaling, lifestyle changes, and cognitive-behavioral skills (Richardson & Rothstein, 2008). Relaxation training emphasizes techniques such as progressive muscle relaxation and deep breathing to improve physical and mental relaxation during episodes of stress, whereas cognitive-behavioral interventions focus on modifying thoughts and perceptions to help individuals respond more favorably to stressful situations (e.g., van der Klink et al., 2001). Interventions that promote healthy lifestyle changes have been shown to promote positive behaviors and reduce feelings of stress (Sonnetag & Frese, 2003). In support of their use for addressing workplace stress, empirical evidence suggests that stress management interventions are effective for reducing stress, improving coping skills, and improving work life well-being (van der Klink et al., 2001; Richardson & Rothstein, 2008). Specifically, Richardson and Rothstein (2008) found a medium-to-large average effect size (Cohen's $d = 0.526$) across the 36 stress management intervention studies included in their study, with cognitive-behavioral interventions displaying the largest average effect (Cohen's $d = 1.164$; Cohen, 1988).

Method

ATC Stress Management Training

Given the stressors reported by ATC trainees at the FAA Academy, a stress management training course was developed for newly hired trainees. The objectives of the training were to improve ATC trainees' understanding and view of stress and provide trainees with stress management techniques for coping with stress in the training environment. The ATC stress management training was adapted from a training program developed by NASA Behavioral Health and Performance for astronaut candidates (NASA, 2017). The training was tailored for the ATC trainee population by incorporating relevant examples and narratives collected from successful ATC trainees who completed FAA Academy training (Barrett et al., 2018). The

training was based on psychological research and presented information on stress, stressors, the consequences of stress, and stress management techniques. To assess whether the stress management training improves the stress management capabilities of ATC trainees, the purpose of this study was to investigate the effectiveness of the training course. More specifically, we examined whether the stress management training positively influenced stress management knowledge, perceived stress management knowledge, confidence in one's ability to manage stress, and the use of stress management techniques during FAA Academy training. We also conducted a one to two month follow-up study to assess if changes were maintained over time. Lastly, we evaluated trainee reactions to the stress management course to examine if ATC trainees found the training to be useful and informative.

Study Sample

Participants in this study were 124 ATC trainees enrolled in Initial Qualification training at the FAA Academy. The stress management training was conducted with 10 Initial Qualification classes: three Initial Tower Cab Training classes ($n = 25$ trainees) and seven Initial En Route Training classes ($n = 99$ trainees). Data were collected as part of a larger research effort examining aptitudes related to controller success. Class sizes ranged from 8 to 18 with a mean class size of 12 trainees ($SD = 3.86$). Participant demographic information was not available for this study. Of the participants, six were excluded from the analysis due to survey-related issues or not consenting to their data being used for this study. The final sample was 118 ATC trainees comprised of 98 En Route trainees and 20 Tower Cab trainees. The sample sizes reported in the results may vary because some trainees did not respond to all of the training evaluation questions and some trainees left the agency prior to the follow-up study.

Procedures

This study utilized a single-group pretest, posttest design to assess changes in learning outcomes attributable to the training course. This pre-experimental design involves comparing the same group of trainees before and after training without the use of a control group and is commonly used in training and education research (Goldstein & Ford, 2002). Prior to the stress

management training, participants completed a stress management knowledge test, a self-report measure of stress management confidence, and a self-report of one's current use of stress management techniques. After the administration of the pretest measures, ATC trainees participated in the stress management training course taught by a researcher working with CAMI's Aerospace Human Factors Research Division. The course was 1.5 to 2 hours in length and the same instructional content was provided to each class. Following the training, participants completed several posttest questionnaires. These measures included the knowledge test, self-report measures of stress management confidence and stress management techniques, and a training reactions survey.

Follow-up assessments occurred approximately 10 days before each class' final performance evaluation, which was roughly one to two months after the stress management training. The final performance evaluation is the final assessment used to determine if a trainee will pass the FAA Academy and advance to field qualification training. During the follow-up assessment, ATC trainees completed the same knowledge test and self-report measure of stress management confidence. Additionally, participants also completed a self-report measure assessing their current use of stress management techniques and a reactions survey asking them to rate their perceptions of the stress management course at this point in their ATC training. In regard to the time between the training and follow-up, Tower Cab trainees participated in the follow-up study approximately one month after the stress management training as the length of Initial Tower Cab Qualification is 37 days, whereas En Route trainees participated in the follow-up approximately two months after the stress management training as the length of Initial En Route Qualification is 57 days.

Training Content

The stress management training was 1.5 to 2 hours in length. The instructional content consisted of three main sections: stress and stressors, lifestyle tips, and stress management techniques. The first section on stress and stressors provided background information on stress, including acute and chronic stressors, internal and external stressors, career-specific stressors, and the physiological and psychological consequences of stress. This section also included

information on positive stress, or eustress, and the role of resilience in responding to and recovering from stressful events. The second section included lifestyle tips and the role of daily habits in managing stress. This section focused on the positive benefits of healthy sleep and exercise habits. The third section focused on specific stress management techniques, which included demonstrations and/or practice opportunities for each technique. The stress management training included information on several cognitive-behavioral and relaxation-based techniques to provide ATC trainees a diverse set of coping strategies. In addition to the lifestyle tips, the specific techniques presented were diaphragmatic breathing, progressive muscle relaxation, rational self-talk, compartmentalization, mindfulness, meditation, and journaling (see **Table 1** for definitions). Participants were provided a training manual, which included information about each of the stress management techniques covered in the course as well as additional scientific information on stress.

Measures

Stress Management Knowledge Test

An 11-item multiple-choice knowledge test, developed by CAMI researchers, was used to evaluate trainee knowledge of stress and stress management concepts. The measure was administered before and after the training course as well as during the follow-up assessment. Example items include “Compartmentalization as a stress management technique works primarily for: (a) long-term, acute stressors, (b) long-term, chronic stressors, (c) short-term acute stressors, or (d) short-term chronic stressors” and “In some acute cases, stress can be a positive experience. (a) True or (b) False”. Appendix A displays the full set of items included in the stress management knowledge test. Internal consistency reliability estimates for the test were calculated using Cronbach’s alpha (α) and were 0.44 at pretest, 0.51 at posttest, and 0.50 at follow-up.

Perceived Stress Management Knowledge

Perceived learning was measured using a single item asking trainees to rate their current level of knowledge about stress management. The item asked, “On a scale of 0-10, rate your

Table 1
Definitions of Stress Management Techniques

Technique	Definition
<i>Good sleep hygiene</i>	The practice of beneficial sleep habits, including sleep scheduling, pre-sleep activities, positive sleep attitudes, daytime behaviors, and the sleep environment (Lacks & Rotert, 1986).
<i>Exercise</i>	An activity requiring physical effort to promote health and wellness.
<i>Mindfulness</i>	A form of meditation that involves nonjudgmental awareness of the present moment. This practice involves focusing on breathing and non-critically on any thoughts that come through the mind (Chiesa & Serretti, 2009).
<i>Diaphragmatic breathing</i>	A deep breathing technique that involves the contraction of the diaphragm, expansion of the belly, and deepening of inhalation and exhalation (Ma et al., 2017).
<i>Progressive muscle relaxation</i>	An exercise to reduce physiological tension that may be held in muscles by slowly tensing and relaxing muscle groups. This exercise involves actively tensing muscles for 5 seconds and releasing the tension slowly for 10-15 seconds while focusing on the feeling of released tension (Jacobson, 1938).
<i>Rational self-talk</i>	A form of cognitive restructuring, this technique involves reframing our initial negative (or self-defeating) thoughts with rational and positive thoughts (Hains, 1992).
<i>Compartmentalization</i>	An attention control technique that involves shifting attention away from the stressful event and focusing on the task at hand (Rose et al., 2013).
<i>Meditation</i>	A practice that involves concentrative or mindfulness techniques. Concentrative techniques involve focusing attention on a single object and then disengaging thoughts and feelings. Mindfulness techniques focus on staying present and alter in the moment (Sedlmeier et al., 2012).
<i>Journaling</i>	The practice of logging stressful events in a journal or diary to monitor stress, identify causes of stress, describe stress reactions, and develop plans for managing stress (Richardson & Rothstein, 2008).

current level of knowledge about stress management” where 0 represents knowing little to nothing about stress management and 10 represents knowing most to everything about stress management. This item was administered before and after the training course as well as during the follow-up assessment.

Trainee Confidence

To assess whether the stress management training improved trainee stress management confidence, two items were administered before and after training as well as during the follow-up assessment. The items were “How confident are you in your ability to use stress management techniques?” and “How confident are you that stress management techniques work for your stress management?”. Items were assessed on a 4-point Likert scale (1 – *not very confident*; 4 – *very confident*).

Trainee Use of Stress Management Techniques

As a central objective of this training was to improve trainee use of stress management techniques while at the FAA Academy, participants were presented several questions about their use of stress management strategies. Prior to training, participants were asked “Do you currently use any stress management techniques while in Academy training?” and, if so, were instructed to list the techniques they used at that time point in training. Following the training, participants were asked if they “learned new stress management techniques from the Stress Management Training” and were asked to identify which techniques from the training were new to them. Lastly, at the follow-up assessment, participants were asked two questions: “Which of the stress management techniques have you used at the FAA Academy?” and “Which techniques were most helpful while at the FAA Academy?” These questions allowed for assessing if the stress management training was related to the techniques reported as being used by ATC trainees. Appendix B shows the questions used to assess trainees’ use of stress management techniques at pretest, posttest, and follow-up.

Trainee Reactions

In addition to examining the effectiveness of the training, we also assessed trainee reactions to the training course. At the end of the training, participants were presented four items asking them about their perceptions of the training: “The training was an effective use of my time”, “The information in this training is important to my success while at the FAA Academy”, “The Stress Management Training was informative”, and “The Stress Management Training was engaging”. These items were rated on a 4-point Likert scale (1 – *completely disagree*; 4 – *completely agree*). At the follow-up assessment, participants were presented two items asking them about their perceptions of the training one to two months after the training: “The information presented in the Stress Management Training has been important to my success at the FAA Academy” and “The information presented in the Stress Management Training will continue to be important to my success at the FAA Academy”. Follow-up items were rated on the same a 4-point scale (1 – *completely disagree*; 4 – *completely agree*).

Analysis

Paired samples t-tests were conducted to evaluate the effectiveness of the stress management training. Training evaluation measures were administered at pretest or prior to the training, at posttest or immediately following the training, and at follow-up or one to two months after the training. Pretest-posttest differences in stress management knowledge, perceived knowledge, and trainee confidence were examined to evaluate the changes in these outcomes immediately following training. Pretest-follow-up differences in stress management knowledge, perceived knowledge, and trainee confidence were examined to evaluate the retention of the training outcomes over time. Increases in test scores and scale ratings would provide evidence for the training’s effectiveness. Cohen’s *d* effect sizes were also reported and provide an estimate of the standardized mean difference in outcomes across time points (Cohen, 1988). Descriptive statistics of trainees’ reported use of stress management techniques and trainees’ reactions to the training course are also reported.

Results

Pretest-Posttest Differences

The first set of analyses involved the comparison of scores on measures administered immediately before and immediately after the stress management training to evaluate the influence of the training on trainees' stress management knowledge, perceived knowledge, and confidence. Independent samples t-tests found no significant differences between En Route and Tower Cab trainees in trainees' stress management knowledge, $t(116) = -1.69, p = .094$, perceived knowledge, $t(110) = 0.52, p = .605$, confidence in their ability to use stress management techniques, $t(116) = 0.59, p = .554$, and confidence that stress management techniques will work for their stress management, $t(116) = 1.83, p = .070$. Based on these results, En Route and Tower Cab trainees were combined for the analyses.

Knowledge and Confidence

Table 2 presents the means, standard deviations, and pretest-posttest differences in stress management knowledge, perceived knowledge, and trainee confidence regarding stress management. For stress management knowledge, a statistically significant increase was observed in knowledge test scores when contrasting posttest and pretest scores, $t(114) = 10.82, p < 0.001$, with a mean increase of 2.12 correct items on the 11-item knowledge test (Cohen's $d = 1.01$). Similarly, a statistically significant increase in perceived stress management knowledge was observed when contrasting posttest and pretest scores, $t(109) = 12.69, p < 0.001$, with a mean increase of 2.71 points on the 0-10 scale (Cohen's $d = 1.21$). For trainee confidence in their ability to use stress management techniques, participants demonstrated a statistically significant increase in confidence following the training, $t(115) = 6.97, p < .001$, with a mean increase of 0.51 points on a 4-point scale (Cohen's $d = 0.64$). For trainee confidence that stress management techniques will work for their stress management, participants also demonstrated a statistically significant increase in confidence following the training, $t(115) = 5.99, p < .001$, with a mean increase of 0.42 points on a 4-point scale (Cohen's $d = 0.56$). **Figure 1** shows the means and standard deviations for the knowledge and confidence outcomes.

Table 2
Pretest and Posttest Differences across Training Outcomes

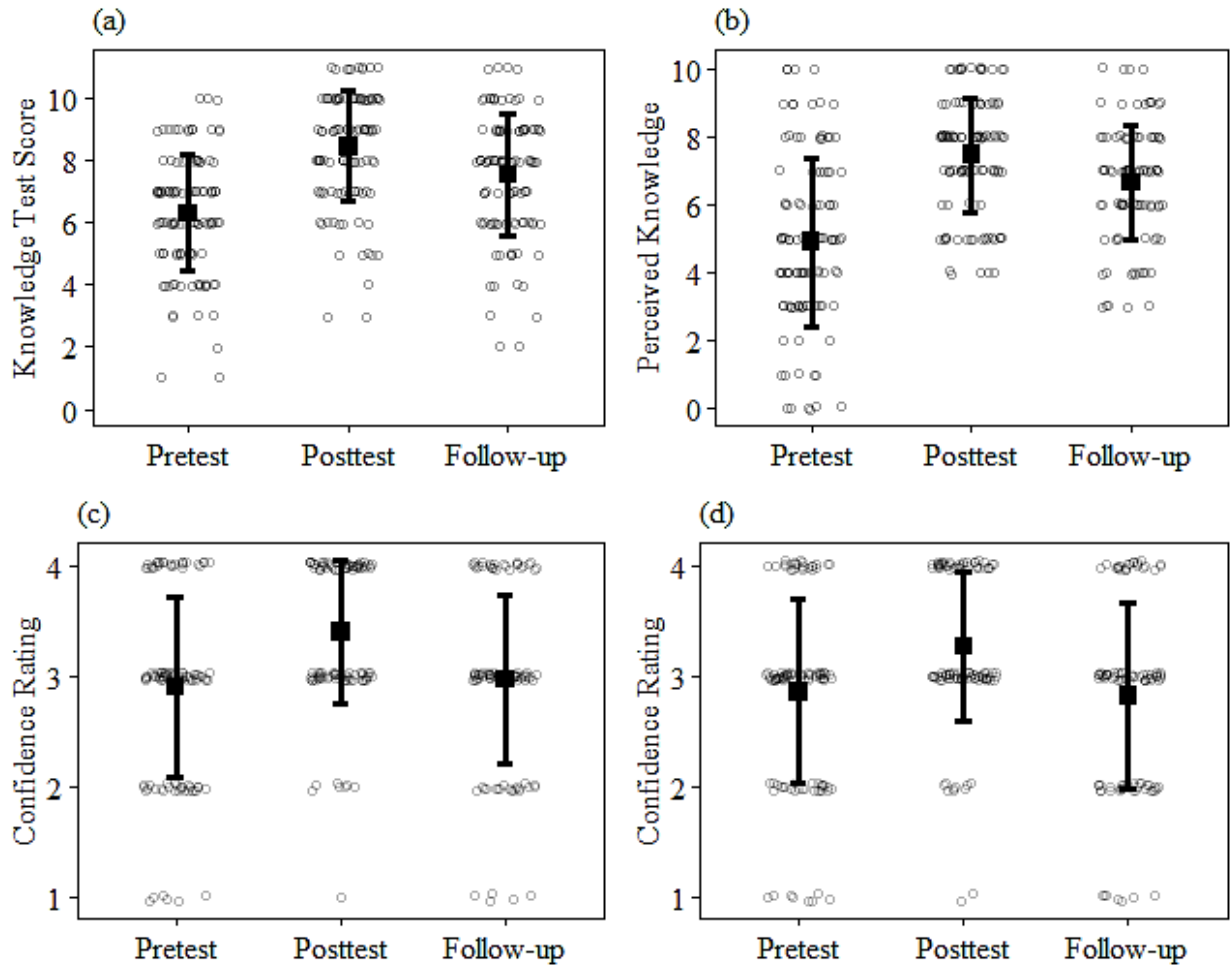
	Pretest		Posttest		t-test			Effect Size
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t-statistic</i>	<i>df</i>	<i>p</i>	Cohen's <i>d</i>
Knowledge	6.34	1.86	8.47	1.79	10.82	114	<.001	1.01
Perceived Knowledge	4.86	2.49	7.57	1.60	12.69	109	<.001	1.21
Confidence ¹	2.89	0.81	3.40	0.64	6.97	115	<.001	0.64
Confidence ²	2.84	0.83	3.27	0.68	5.99	115	<.001	0.56

Note. *N* = 115 for knowledge test. *N* = 110 for perceived knowledge. *N* = 116 for confidence. ¹ Confidence in ability to use stress management techniques. ² Confidence that stress management techniques will work for stress management.

Stress Management Techniques

Prior to training, 49.6% of the participants reported that they were concurrently using stress management techniques while at the FAA Academy. The most commonly listed techniques by these participants included exercise, breathing techniques, meditation, and sleep. Following the training, 85.2% of participants reported learning a new stress management technique from the training course. The percentage of trainees reporting each stress management techniques as new is as follows: progressive muscle relaxation (44.1%), rational self-talk (39.8%), mindfulness (30.5%), compartmentalization (29.7%), journaling (28.0%), diaphragmatic breathing (21.2%), good sleep hygiene (14.4%), meditation (9.3%), and regular exercise (2.5%). Additionally, trainees were asked to report which of the stress management techniques they planned to use while at the FAA Academy. The percentage for each technique is as follows: good sleep hygiene (66.1%), regular exercise (50.8%), diaphragmatic breathing (50.0%), rational self-talk (45.8%), compartmentalization (43.2%), mindfulness (37.3%), progressive muscle relaxation (35.6%), meditation (33.9%), and journaling (7.6%).

Figure 1
Means and Standard Deviations of Training Outcomes



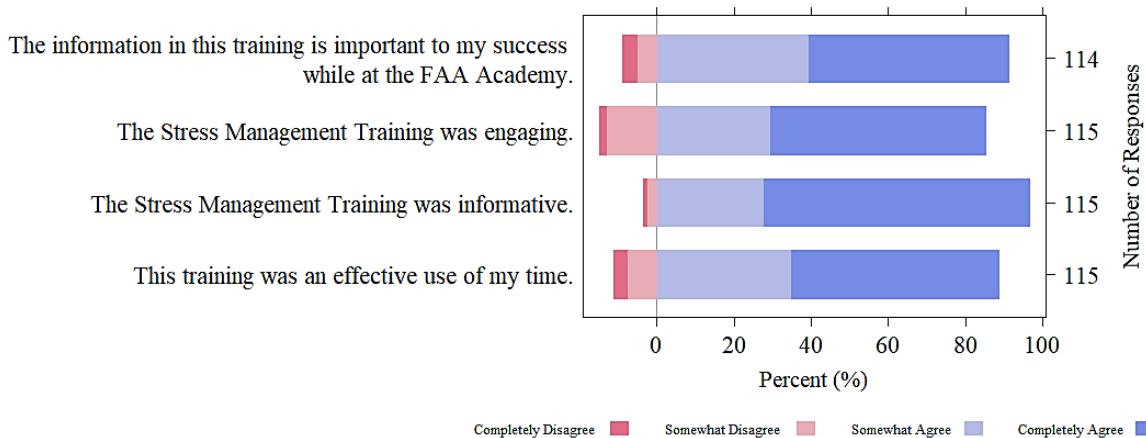
Note. Means and standard deviations of outcomes at pretest, posttest, and follow-up for (a) stress management knowledge test scores, (b) perceived stress management knowledge ratings, (c) confidence in ability to use stress management techniques ratings, and (d) confidence that stress management techniques will work ratings. Raw data are jittered to visualize overlapping values.

Post-Training Reactions

Participants viewed the stress management training positively and believed the training was informative and engaging. On a 4-point scale (1 – *completely disagree*, 4 – *completely agree*), the majority of participants completely agreed that the training was an effective use of their time ($M = 3.39$, $SD = 0.78$), that the training was important to their success while at the

Figure 2

Trainees' Post-Training Reactions to the Stress Management Training Course



Note. Survey responses to the post-training reaction questions. Each participant selected one of four levels of agreement. This figure displays the breakdown of respondents into four categories.

FAA Academy ($M = 3.39$, $SD = 0.75$), that the stress management training was informative ($M = 3.64$, $SD = 0.58$), and that the stress management training was engaging ($M = 3.39$, $SD = 0.78$).

Figure 2 displays the percentage of participants who completely disagreed, somewhat disagreed, somewhat agreed, and completely agreed with these statements about the training.

Pretest-Follow-up Differences

The second set of analyses involved the comparison of scores on measures administered immediately before and one to two months after the stress management training to evaluate the retention of trainees' stress management knowledge, perceived knowledge, and confidence. Given the differences in training length between Initial Tower Cab Training and Initial En Route Training, Tower Cab trainees participated in the follow-up roughly one month after the stress management training and En Route trainees participated in the follow-up roughly two months after the stress management training. Despite the differences in the training length, independent samples t-tests found no significant differences between En Route and Tower Cab trainees in trainees' stress management knowledge, $t(110) = 0.19$, $p = .849$, perceived knowledge, $t(101) = -1.25$, $p = .214$, confidence in their ability to use stress management techniques, $t(110) = 0.19$, $p = .852$, and confidence that stress management techniques will work for their stress management,

$t(109) = 0.29, p = .771$. As such, En Route and Tower Cab trainees were combined for these analyses as well.

Knowledge and Confidence

To assess if the training effects were maintained over time, participants completed the knowledge test and self-report measures of perceived knowledge and confidence one to two months after the training. **Table 3** presents the results of the comparison of pretest and follow-up scores. Participants demonstrated maintenance of stress management knowledge when contrasting follow-up and pretest knowledge scores, $t(111) = 7.41, p < .001$, as scores were significantly higher at follow-up with a mean increase of 1.33 correct items on the 11-item knowledge test (Cohen's $d = 0.70$). Participants also maintained their perception of their own stress management knowledge as perceived stress management knowledge ratings at follow-up were significantly higher than pretest ratings, $t(97) = 8.25, p < .001$, with a mean increase of 1.88 points on the 0-10 scale (Cohen's $d = 0.83$). However, trainee confidence in their stress management was not maintained over time. There were no significant differences found in trainees' rating in confidence in their ability to use stress management techniques ($t(111) = 1.15, p = .253$, Cohen's $d = 0.10$) or that stress management techniques will work for their stress management ($t(110) = -0.894, p = .373$, Cohen's $d = -0.08$) between pretest and follow-up scores. **Figure 1** shows the means and standard deviations for the knowledge and confidence outcomes.

Stress Management Techniques

Participants also reported the stress management techniques that they were currently using at the FAA Academy. At follow-up, 84.8% of participants reported that they were using at least one stress management technique as compared to the 49.6% using stress management techniques prior to training. For the trainees that indicated that they were currently using stress management techniques, approximately 90% reported using two or more techniques with 33% of those using three techniques and 28.4% using four techniques. The percentage of trainees indicating that they were currently using each stress management techniques is as follows: good sleep hygiene (70.3%), rational self-talk (52.5%), diaphragmatic breathing (42.4%), mindfulness (38.1%), compartmentalization (37.3%), regular exercise (34.7%), meditation (12.7%),

Table 3*Pretest and Follow-up Differences across Training Outcomes*

	Pretest		Follow-up		t-test			Effect Size
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t-statistic</i>	<i>df</i>	<i>p</i>	Cohen's <i>d</i>
Knowledge	6.22	1.86	7.55	1.93	7.41	111	<.001	0.70
Perceived Knowledge	4.84	2.49	6.71	1.67	8.25	97	<.001	0.83
Confidence ¹	2.88	0.68	2.97	0.77	1.15	111	.253	0.10
Confidence ²	2.89	0.81	2.82	0.84	-0.89	110	.373	-0.08

Note. *N* = 112 for knowledge test. *N* = 98 for perceived knowledge. *N* = 112 and 111 for confidence, respectively. ¹ Confidence in ability to use stress management techniques. ² Confidence that stress management techniques will work for stress management.

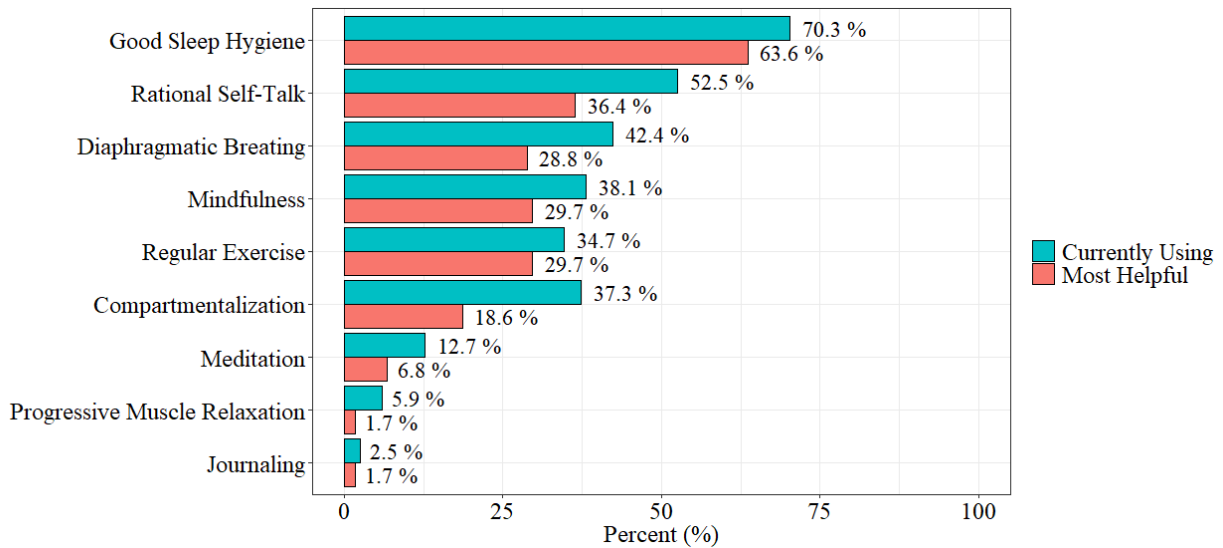
progressive muscle relaxation (5.9%), and journaling (2.5%). Participants also reported which stress management techniques taught during the training have been the most helpful during their time at the FAA Academy. The percentage of trainees reporting each of the stress management techniques as helpful is as follows: good sleep hygiene (63.6%), rational self-talk (36.4%), mindfulness (29.7%), regular exercise (29.7%), diaphragmatic breathing (28.8%), compartmentalization (18.6%), meditation (6.8%), progressive muscle relaxation (1.7%), and journaling (1.7%). **Figure 3** displays the percentage breakdown.

Training Reactions

Lastly, participants also retained their positive perceptions of the training course one to two months after participating in the training. The majority of trainees agreed that the information presented in the stress management training has been important to their success (*M* = 2.79, *SD* = 0.75) and will continue to be important to their success at the FAA Academy (*M* = 2.79, *SD* = 0.80). **Figure 4** displays the percentage of participants who completely disagreed, somewhat disagreed, somewhat agreed, and completely agreed with these statements about the training.

Figure 3

Percentage of Techniques Reported as Currently Being Used and as Most Helpful



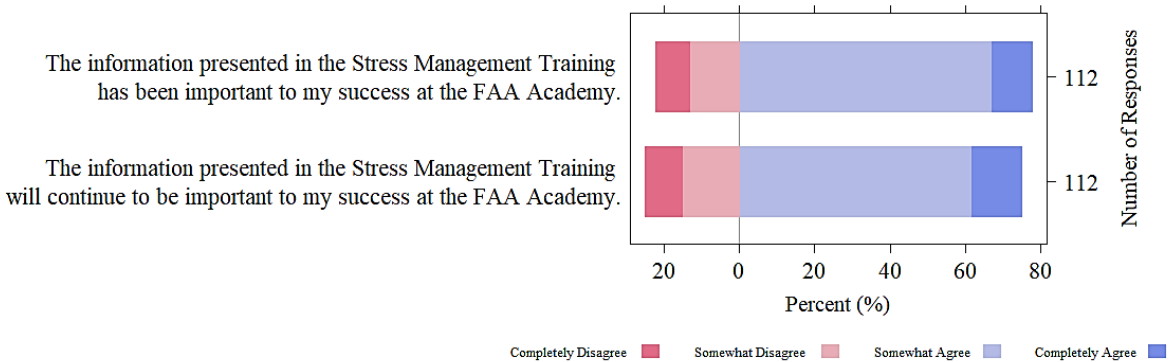
Note. Percentage breakdown of survey responses to the questions asking participant to indicate which stress management techniques that they are currently using and those that they have found most helpful during the follow-up assessment.

Discussion

Training at the FAA Academy is a stressful experience for newly hired ATC trainees, as their career in the controller occupation is dependent on their ability to pass a combination of classroom tests and graded simulations. At the FAA Academy, trainees have to deal with a variety of stressors including high-stakes performance evaluations, fast-paced instruction, and job uncertainty (Barrett et al., 2018) and stressors such as these have the potential to negatively impact trainee performance and well-being (Sonnetag & Frese, 2003). In response to evidence suggesting that trainees may benefit from assistance in managing their stress, a stress management training was developed for ATC trainees. The ATC stress management training is a two-hour course that provides information on stress, stressors, the consequences of stress, and stress management techniques. The training is based on psychological research and its purpose is to enhance trainees' understanding of stress and improve their repertoire of stress management techniques.

Figure 4

Trainees' Follow-up Reactions to the Stress Management Training Course



Note. Survey responses to the training reaction questions administered at follow-up. Each participant selected one of four levels of agreement. This figure displays the breakdown of respondents into four categories.

In the present study, we examined the effectiveness of the stress management training course in improving the stress management knowledge and stress management usage of ATC trainees. Findings from this study point to several conclusions about the effectiveness of this training. First, participants scored significantly higher on the stress management knowledge test immediately following training and, most importantly, maintained this knowledge over time. Second, participants reported higher levels of perceived stress management knowledge following the training, such that after the training participants felt as though they knew more about stress management. This belief was also maintained over time. A primary objective of this stress management training was to impart a more complete understanding of stress and stressors to ATC trainees, and these findings suggest that the stress management training was associated with beneficial gains in knowledge. Improving the stress management knowledge of trainees provides a foundation on which they can develop and acquire stress management skills (Saunders et al., 1996).

Third, participants showed increases in confidence in their ability to use stress management techniques and confidence that stress management techniques can work for their stress management immediately following the training. However, confidence in both of these areas was not maintained over time. One explanation as to why confidence levels were not

maintained could be because of the timing of the follow-up assessment. Follow-up assessments occurred roughly 10 days before the trainees' final performance evaluations. This time is likely a period of high stress and uncertainty, given these performance evaluations have a substantial influence on passing the FAA Academy. Another potential explanation could be a lack of targeted practice for building one's stress management skills and confidence. In contrast with the findings above, it is interesting that stress management confidence among the trainees was not maintained even though there was evidence for the retention of objective and perceived knowledge. This finding points to the need for additional resources or opportunities that allow trainees to build their confidence in developing their stress management skills and utilizing them in different types of ATC situations. Confidence and self-efficacy are critical for the stress management process as confidence underlies an individual's competence or capacity to manage their own stress (Sonnentag & Frese, 2003).

Fourth, reported changes in stress management techniques were also observed in this evaluation effort. Approximately 85% of trainees reported learning a new stress management technique from the training suggesting that the training course covered strategies for coping with stress that were previously unfamiliar to the trainees. Furthermore, roughly 85% of trainees reported that they were using stress management techniques at the time of the follow-up assessment, compared to the 50% of trainees that reported using stress management techniques prior to participating in the training. While this indicates an increase in the use of stress management techniques by those that participated in the training, we cannot claim that the training caused this reported increase. It is possible that this increase was due to the demands of Initial Qualification training being higher than the demands of the Basics training course resulting in more trainees using stress management techniques at that time. However, a substantial number of trainees reported using multiple strategies covered in the stress management course during their time at the FAA Academy. These results suggest that stress management training was potentially helpful in broadening the repertoire of trainees' stress management skills as a considerable proportion of trainees reported that they learned and implemented a new stress management technique discussed during the training. While it does appear that the stress management training exhibited positive benefits in the acquisition of stress management skills, we are unable to draw causal conclusions from these data given that we do

not have a comparison group. Additionally, these results do not speak to how effectively ATC trainees used these techniques during their time in FAA Academy training. Additional research should explore how effectively ATC trainees use stress management techniques during training, particularly during the skill-building components of training.

Lastly, in this effort, we also examined trainee reactions to the stress management training to evaluate if ATC trainees found the training course to be beneficial to their success. In general, the majority of trainees viewed the training as an effective use of their time, important to their success while at the FAA Academy, informative, and engaging. Additionally, the majority of trainees held similar views of the stress management training one to two months after participating in the course. Specifically, trainees rated the training course as important to their success and as something that will continue to be important to their success at the FAA Academy. Given the finite amount of time ATC trainees have at the FAA Academy to learn ATC, the positive reactions to this stress management course suggest that trainees find information related to stress management to be valuable for their learning experiences and career as a controller.

Implications and Future Directions

The results of this study also point to several implications and potential avenues for stress management interventions in the controller occupation. Trainees found the FAA Academy training process to be stressful, but the stress associated with controlling air traffic continues beyond FAA Academy training likely increasing when trainees begin to work with live traffic. Therefore, building stress management skills early in the training process can produce positive benefits for training and on the job as well. Edwards et al. (2014) found that controllers reported that stress on the job led to feelings of anxiety, nervousness, increased heart rate, and slower thinking, all of which have the potential to impact a controller's ability to control air traffic negatively. Stress management interventions, such as the training course reported here, may serve to help controllers develop the skills necessary for dealing with stress on the job and, as such, provide benefits to trainees as well as certified professional controllers. Providing trainees a stress management guide that provides instructions on different stress management techniques

can serve as a refresher on the different coping strategies that they can use to combat stress. Providing dedicated practices opportunities that allow to trainees to work on implementing different stress management strategies while controlling air traffic may be a helpful skill building activity as well. Additionally, encouraging peer groups or teams may also serve as a benefit to trainee stress management. Pierce et al. (2018) found that ATC trainees valued study groups and saw them as an important resource for the FAA Academy training process. Promoting the use of study/peer groups for learning as well as an outlet for stress management may assist trainees in dealing with the various stressors faced during training.

Training failures represent a significant financial cost for the FAA given the monetary investment that the FAA makes in training newly hired ATC trainees (see FAA, 2019). The stress experienced during training may be contributing to training failures and preventing otherwise qualified candidates from progressing through the ATC training process. The extent to which the stress management training improves the ability of trainees to deal with stressors faced at the FAA Academy, or in the field, can have positive effects not just for individual trainees, but the FAA as a whole. Teaching stress management skills to ATC trainees may improve the success of ATC trainees and save the FAA from increased training costs. Future research should explore the direct relationship between stress management and trainee pass rates and time to certification.

Limitations

Several limitations of the present study must also be noted. First, the use of the single-group, pretest-posttest design limits the extent to which conclusions can be drawn about the training *causing* changes in training outcomes as there is no comparison group. The effects evidenced in single group designs may be attributable to testing effects when the same tests are administered before and after the training. However, the maintenance of knowledge over a one to two month period suggests that testing effects are less likely to be a reason for the observed effects. Similarly, trainee changes that occurred outside the training environment and/or the maturation of trainees during the training process may have influenced the findings of this study (Goldstein & Ford, 2002; Knapp, 2016). For instance, we are unable to tease apart whether the

stress management training lead to an increased use of stress management techniques by trainees or if increasing stressors in the training environment lead to an increase in the use of stress management techniques. Overall, the training does appear to provide a positive benefit to ATC trainees. However, we are unable to make causal claims about the effects of the training without the use of a control group for comparison. To validate the utility of the training further, it would be helpful to determine whether ATC trainees who completed the stress management training were more likely to pass the FAA Academy training program.

Second, the effectiveness of the training may be influenced by individual differences variables such as stress mindset or openness. Stress mindset, or the extent to which an individual views stressful events as threatening and debilitating or enhancing and challenging (Crum, Salovey, & Achor, 2013), may influence whether an individual perceives the training as valuable and influence who is able to effectively implement stress management techniques during training or on the job. Third, results from this study do not speak to how trainees implemented their stress management knowledge and skills during FAA Academy training. The implementation of the knowledge and skills acquired in the stress management training is likely to be influential in whether stress management contributes to training success or training failure. The manner in which stress management strategies are implemented during testing or performance evaluations is critical for successfully coping with stressors. The number of strategies used by a trainee may also contribute to effectively managing one's stress as individuals with a broader range of strategies at their disposal may be better equipped to face different types of stressful environments. The role of multiple stress management techniques in ATC stress may be an area worthy of future investigation.

Conclusions

The ATC stress management training was developed to assist newly hired trainees in managing their stress at the FAA Academy. Overall, the training was associated with positive gains in both objective and perceived stress management knowledge as well as initial improvements in stress management confidence. The stress management training also contributed to trainees learning new stress management techniques and using these techniques

during their time at the FAA Academy. Moreover, ATC trainees had positive perceptions of the course and found the training to be engaging, informative, and important to their success. This study provides evidence for the usefulness of the ATC stress management training in teaching trainees how to manage their stress. Currently, the ATC stress management training is delivered to ATC trainees as a module in the Air Traffic Basics course.

References

- Alford, W. K., Malouff, J. M., & Osland, K. S. (2005). Written emotional expression as a coping method in child protective services officers. *International Journal of Stress Management, 12*(2), 177-187. <https://doi.org/10.1037/1072-5245.12.2.177>
- Barrett, J. D., Pierce, L. G., Buck, J., Paoletti, J., & Slack, K. J. (2018, August). *Measuring and managing trainee stress in FAA Academy air traffic control training* [Paper presentation]. 125th American Psychological Association Annual Conference, San Francisco, CA.
- Bond, F. W., & Bunce, D. (2000). Mediators of change in emotion-focused and problem-focused worksite stress management interventions. *Journal of Occupational Health Psychology, 5*(1), 156-163. <https://doi.org/10.1037/1076-8998.5.1.156>
- Chajut, E., & Algom, D. (2003). Selective attention improves under stress: Implications for theories of social cognition. *Journal of Personality and Social Psychology, 85*(2), 231-248. <https://doi.org/10.1037/0022-3514.85.2.231>
- Chiesa, A., & Serretti, A. (2009). Mindfulness-based stress reduction for stress management in healthy people: A review and meta-analysis. *The Journal of Alternative and Complementary Medicine, 15*(5), 593-600. <https://doi.org/10.1089/acm.2008.0495>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Erlbaum.
- Costa, G. (1995). *Occupational stress and stress prevention in air traffic control* (Working Paper No. CONDI/T/WP.6/1995). International Labour Office.
- Crum, A. J., Salovey, P., & Achor, S. (2013). Rethinking stress: The role of mindsets in determining the stress response. *Journal of Personality and Social Psychology, 104*(4), 716-733. <https://doi.org/10.1037/a0031201>
- Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety*. Jossey-Bass Publishers.
- Della Rocco, P. S. (1999). *The role of shift work and fatigue in air traffic control operational errors and incidents* (Report No. DOT/FAA/AM-99/2). Federal Aviation Administration. Retrieved from https://www.faa.gov/data_research/research/med_humanfacs/oamtechreports/1990s/media/AM99-02.pdf
- Edwards, T., Sharples, S., Kirwan, B., Wilson, J. R., & Balfe, N. (2014). Identifying markers of performance decline in air traffic controllers. In T. Ahram, W. Karwowski, & T. Marek (Eds.), *Proceedings of the 5th International Conference on Applied Human Factors and Ergonomics 2014* (pp 19-23). Kraków, Poland: AHFE.
- Federal Aviation Administration. (2019). *Air traffic controller workforce plan 2019-2028*. Retrieved from on December 1, 2020, from https://www.faa.gov/air_traffic/publications/controller_staffing/

- Garst, H., Frese, M., & Molenaar, P. (2000). The temporal factor of change in stressor–strain relationships: A growth curve model on a longitudinal study in East Germany. *Journal of Applied Psychology, 85*(3), 417-438. <https://doi.org/10.1037/0021-9010.85.3.417>
- Gilboa, S., Shirom, A., Fried, Y., & Cooper, C. (2008). A meta-analysis of work demand stressors and job performance: Examining main and moderating effects. *Personnel Psychology, 61*(2), 227-271. <https://doi.org/10.1111/j.1744-6570.2008.00113.x>
- Glaser, D. N., Tatum, B. C., Nebeker, D. M., Sorenson, R. C., & Aiello, J. R. (1999). Workload and social support: Effects on performance and stress. *Human Performance, 12*(2), 155-176. <https://doi.org/10.1080/08959289909539865>
- Goldstein, I. L. and Ford, J. K. (2002), *Training in organizations* (4th ed.). Wadsworth.
- Hains, A. A. (1992). Comparison of cognitive-behavioral stress management techniques with adolescent boys. *Journal of Counseling & Development, 70*(5), 600-605. <https://doi.org/10.1002/j.1556-6676.1992.tb01668.x>
- Holman, D., Johnson, S., & O'Connor, E. (2018). Stress management interventions: Improving subjective psychological well-being in the workplace. In E. Diener, S. Oishi, & L. Tay (Eds.), *Handbook of well-being*. DEF Publishers.
- Ivancevich, J. M., Matteson, M. T., Freedman, S. M., & Phillips, J. S. (1990). Worksite stress management interventions. *American Psychologist, 45*(2), 252-261. <https://doi.org/10.1037/0003-066X.45.2.252>
- Jacobson, E. (1938). *Progressive relaxation* (2nd ed.). University of Chicago Press.
- Joëls, M., Pu, Z., Wiegert, O., Oitzl, M. S., & Krugers, H. J. (2006). Learning under stress: How does it work? *Trends in Cognitive Sciences, 10*(4), 152-158. <https://doi.org/10.1016/j.tics.2006.02.002>
- Kavanagh, M. J., Hurst, M. W., & Rose, R. (1981). The relationship between job satisfaction and psychiatric health symptoms for air traffic controllers. *Personnel Psychology, 34*(4), 691-707. <https://doi.org/10.1111/j.1744-6570.1981.tb01424.x>
- Klein, K., & Boals, A. (2001). The relationship of life event stress and working memory capacity. *Applied Cognitive Psychology, 15*(5), 565-579. <https://doi.org/10.1002/acp.727>
- Knapp, T. R. (2016). Why is the one-group pretest–posttest design still used? *Clinical Nursing Research, 25*(5), 467-472. <https://doi.org/10.1177/1054773816666280>
- Lacks, P., & Rotert, M. (1986). Knowledge and practice of sleep hygiene techniques in insomniacs and good sleepers. *Behaviour Research and Therapy, 24*(3), 365-368. [https://doi.org/10.1016/0005-7967\(86\)90197-X](https://doi.org/10.1016/0005-7967(86)90197-X)

- Lazarus, R.S., DeLongis, A., Folkman, S. & Gruen, R. (1985). Stress and adaptational outcomes: The problem of confounded measures. *American Psychologist*, 40(7), 770–779. <https://doi.org/10.1037/0003-066X.40.7.770>
- Lazarus, R.S., & Folkman, S. (1984). *Psychological stress and the coping process*. Springer.
- LePine, J. A., LePine, M. A., & Jackson, C. L. (2004). Challenge and hindrance stress: Relationships with exhaustion, motivation to learn, and learning performance. *Journal of Applied Psychology*, 89(5), 883-891. <http://dx.doi.org/10.1037/0021-9010.89.5.883>
- Ma, X., Yue, Z. Q., Gong, Z. Q., Zhang, H., Duan, N. Y., Shi, Y. T., Wei, G. X., & Li, Y. F. (2017). The effect of diaphragmatic breathing on attention, negative affect and stress in healthy adults. *Frontiers in Psychology*, 8, 874. <https://doi.org/10.3389/fpsyg.2017.00874>
- Motowidlo, S. J., Packard, J. S., & Manning, M. R. (1986). Occupational stress: Its causes and consequences for job performance. *Journal of Applied Psychology*, 71(4), 618-629. <http://dx.doi.org/10.1037/0021-9010.71.4.618>
- Moyle, P., & Parkes, K. (1999). The effects of transition stress: A relocation study. *Journal of Organizational Behavior*, 20(5), 625-646. [https://doi.org/10.1002/\(SICI\)1099-1379\(199909\)20:5%3C625::AID-JOB898%3E3.0.CO;2-7](https://doi.org/10.1002/(SICI)1099-1379(199909)20:5%3C625::AID-JOB898%3E3.0.CO;2-7)
- National Aeronautics and Space Administration. (2017). *Stress management training manual* (Unpublished internal document).
- Pierce, L.G. (2017, February). *Academy training outcomes by class* (Unpublished internal document). Federal Aviation Administration Civil Aerospace Medical Institute.
- Pierce, L., Buck, J., & Barrett, J. (2018, August). *The role of study groups in learning to control air traffic*. Paper presented at the 125th American Psychological Association Annual Conference, San Francisco, CA.
- Pruitt, R. H. (1992). Effectiveness and cost efficiency of interventions in health promotion. *Journal of Advanced Nursing*, 17(8), 926-932. <https://doi.org/10.1111/j.1365-2648.1992.tb02020.x>
- Reese, N. & Heil, M. (1999). FAA air traffic controller selection in the United States. In H. Eißfledt, M. Heil, & D. Broach (Eds.), *Staffing the ATM system: The selection of air traffic controllers* (pp. 109-120). Ashgate.
- Richardson, K. M., & Rothstein, H. R. (2008). Effects of occupational stress management intervention programs: A meta-analysis. *Journal of Occupational Health Psychology*, 13(1), 69-93. <https://doi.org/10.1037/1076-8998.13.1.69>
- Rose, R. D., Buckley Jr, J. C., Zbozinek, T. D., Motivala, S. J., Glenn, D. E., Cartreine, J. A., & Craske, M. G. (2013). A randomized controlled trial of a self-guided, multimedia, stress

- management and resilience training program. *Behaviour Research and Therapy*, 51(2), 106-112. <https://doi.org/10.1016/j.brat.2012.11.003>
- Rydstedt, L. W., Johansson, G., & Evans, G. W. (1998). A longitudinal study of workload, health and well-being among male and female urban bus drivers. *Journal of Occupational and Organizational Psychology*, 71(1), 35-45. <https://doi.org/10.1111/j.2044-8325.1998.tb00661.x>
- Saunders, T., Driskell, J. E., Johnston, J. H., & Salas, E. (1996). The effect of stress inoculation training on anxiety and performance. *Journal of Occupational Health Psychology*, 1(2), 170-186. <https://doi.org/10.1037/1076-8998.1.2.170>
- Schumacher, D., Schreurs, B., Van Emmerik, H., & De Witte, H. (2016). Explaining the relation between job insecurity and employee outcomes during organizational change: A multiple group comparison. *Human Resource Management*, 55(5), 809-827. <https://doi.org/10.1002/hrm.21687>
- Sedlmeier, P., Eberth, J., Schwarz, M., Zimmermann, D., Haarig, F., Jaeger, S., & Kunze, S. (2012). The psychological effects of meditation: A meta-analysis. *Psychological Bulletin*, 138(6), 1139-1171. <https://doi.org/10.1037/a0028168>
- Shapiro, S. L., Astin, J. A., Bishop, S. R., & Cordova, M. (2005). Mindfulness-based stress reduction for health care professionals: Results from a randomized trial. *International Journal of Stress Management*, 12(2), 164-176. <https://doi.org/10.1037/1072-5245.12.2.164>
- Sonnentag, S., & Frese, M. (2003). Stress in organizations. In W. C. Borman, D. R. Ilgen, & R. J. Klimoski (Eds.), *Comprehensive handbook of psychology, Volume 12: Industrial and organizational psychology* (pp. 453-491). Wiley.
- Tafalla, R. J., & Evans, G. W. (1997). Noise, physiology, and human performance: The potential role of effort. *Journal of Occupational Health Psychology*, 2(2), 148-155. <https://doi.org/10.1037/1076-8998.2.2.148>
- U.S. Department of Transportation Office of the Inspector General. (2004, June). *Addressing controller attrition: Opportunities and challenges facing the Federal Aviation Administration* (Report No. CC-2004-058). Department of Transportation. Retrieved from <https://www.oig.dot.gov/library-item/30650>
- U.S. Department of Transportation Office of the Inspector General. (2008, June). *Review of the air traffic control facility training program* (Report No. AV-2008-055). Department of Transportation. Retrieved from <https://www.oig.dot.gov/library-item/29697>
- Van der Klink, J. J., Blonk, R. W., Schene, A. H., & Van Dijk, F. J. (2001). The benefits of interventions for work-related stress. *American Journal of Public Health*, 91(2), 270-276. <https://dx.doi.org/10.2105%2Fajph.91.2.270>

- Vrijkotte, T. G., Van Doornen, L. J., & De Geus, E. J. (2000). Effects of work stress on ambulatory blood pressure, heart rate, and heart rate variability. *Hypertension*, 35(4), 880-886. <https://doi.org/10.1161/01.HYP.35.4.880>
- Warm, J. S., Matthews, G., & Finomore, V. S. (2018). Vigilance, workload, and stress. In J. L. Szalma & P. A. A. Hancock (Eds.), *Performance under stress* (pp. 115-141). London: CRC Press.
- Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit formation. *Journal of Comparative Neurology and Psychology*, 18(5), 459-482. <https://doi.org/10.1002/cne.920180503>

Appendix A
Stress Management Knowledge Test

1. Chronic stressors are:
 - a. unrelenting and seem never ending.
 - b. internal or external.
 - c. brought from demands and pressures that seem to have no solution.
 - d. all of the above.
2. Strain is:
 - a. felt primarily in the physical health of the body as a result of over exposure to stress.
 - b. felt primarily through the physiological, psychological and/or behavioral deviation from healthy functioning.
 - c. felt primarily in one's physiological health as a result of over exposure to stress.
 - d. felt primarily in one's behavioral health as a result of over exposure to stress.
3. People who believed that stress was not harmful for their health had _____ risk of dying.
 - a. Low
 - b. Moderate
 - c. High
 - d. No change in the
4. In some acute cases, stress can be a positive experience.
 - a. True
 - b. False
5. What is the primary difference between *eustress* and distress ?
 - a. Eustress is short-term, while distress is primarily long-term.
 - b. Eustress is negative, while distress is positive.
 - c. Eustress cannot be experienced at the same time as distress.
 - d. Eustress leads to mental issues, while distress leads to physical issues.
6. Resilience to stress can
 - a. cause physical health concerns later in life.
 - b. result in better recovery from stressors over time.
 - c. only be built within individuals who are born with it.
 - d. only be helpful to dealing with acute stressors.

7. Mindfulness means
 - a. to think of how my actions affect others.
 - b. to consider the meaning of what others say, rather than how they say it.
 - c. to focus on the "now".
 - d. to plan for the future by considering my past, current, and possible future decisions.
8. Ignoring distractions and stressors while focusing on a present issue is called:
 - a. Compartmentalization
 - b. Mindfulness
 - c. Strain
 - d. Resilience
9. Compartmentalization as a stress management technique works primarily for
 - a. long-term, acute stressors
 - b. long-term, chronic stressors
 - c. short-term, acute stressors
 - d. short-term, chronic stressors
10. Progressive Muscle Relaxation as a stress management technique is best used
 - a. prior to going to sleep.
 - b. during a stressful event.
 - c. just before an anticipated stressful event.
 - d. just after a stressful event.
11. Rational Self-Talk as a stress management technique involves
 - a. understanding that our first response to a stressful event should be positive.
 - b. understanding that our first response to a stressful event is a reflection of reality.
 - c. training ourselves to have automatic, positive feelings during stressful events.
 - d. training ourselves to reframe our responses to stressful events with rationality.

Appendix B

Stress Management Technique Measure

Pretest

1. Do you currently use any stress management techniques while in Academy training?
 - a. Yes
 - b. No
 - c. I'm not sure
2. Briefly list the stress management techniques you currently use.

Posttest

1. I learned new stress management techniques from the Stress Management Classroom Training.
 - a. Yes
 - b. No
 - c. I'm not sure.
2. In today's Stress Management Classroom Training, which stress management techniques were new to you (e.g., you did not know of them before today)? [All that apply]
 - a. Good Sleep Hygiene
 - b. Regular Exercise
 - c. Mindfulness
 - d. Diaphragmatic Breathing
 - e. Progressive Muscle Relaxation
 - f. Rational Self-Talk
 - g. Compartmentalization
 - h. Meditation

- i. Journaling
- 3. Of the stress management techniques presented, which techniques do you plan to use while at FAA Academy training? [All that apply]
 - a. Good Sleep Hygiene
 - b. Regular Exercise
 - c. Mindfulness
 - d. Diaphragmatic Breathing
 - e. Progressive Muscle Relaxation
 - f. Rational Self-Talk
 - g. Compartmentalization
 - h. Meditation
 - i. Journaling

Follow-up

- 1. Do you currently use any stress management techniques?
 - a. Yes
 - b. No
 - c. I'm not sure
- 2. Of the stress management techniques presented during your Stress Management Briefing, which techniques do you currently use while at FAA Academy training [select all that apply]?
 - a. Good Sleep Hygiene
 - b. Regular Exercise
 - c. Mindfulness
 - d. Diaphragmatic Breathing
 - e. Progressive Muscle Relaxation
 - f. Rational Self-Talk
 - g. Compartmentalization
 - h. Meditation
 - i. Journaling
 - j. None of these (explain)

3. Of the stress management techniques presented, which techniques have you found the most helpful while at FAA Academy training [select all that apply]?

- a. Good Sleep Hygiene
- b. Regular Exercise
- c. Mindfulness
- d. Diaphragmatic Breathing
- e. Progressive Muscle Relaxation
- f. Rational Self-Talk
- g. Compartmentalization
- h. Meditation
- i. Journaling