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TITLE: Refinement and Validation of a Military Emotional Intelligence Training Program

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14. ABSTRACT The goal of this project was to provide the U.S. military with a brief, well-validated, Internet-based program for emotional intelligence training (EIT). This objective was accomplished via six sequential Tasks. During Task 1, a web-based training program was developed and programmed. Task 2 focused on improving the program through a series of iterative administrations, feedback, and refinement. In Task 3, the final EIT program was validated against a matched placebo training program (n = 435 participants from the general population). Task 4 provided further validation using functional magnetic resonance imaging (fMRI) by showing that the program was associated with meaningful changes in brain function (n = 69). Task 5 evaluated the effectiveness of the program in ROTC cadets (n = 134), and Task 6 evaluated effectiveness in active-duty military personnel (n = 209). Across these independent studies, the EIT program resulted in significantly greater improvement on measures of emotional intelligence traits and abilities, emotional competencies, resilience skills, and mental health, including protection against suicidal ideation. The EIT program was most effective for those who started the training with deficiencies in emotional competencies. This project has yielded an effective, validated, and easily administered approach for enhancing emotional skills in military personnel.					
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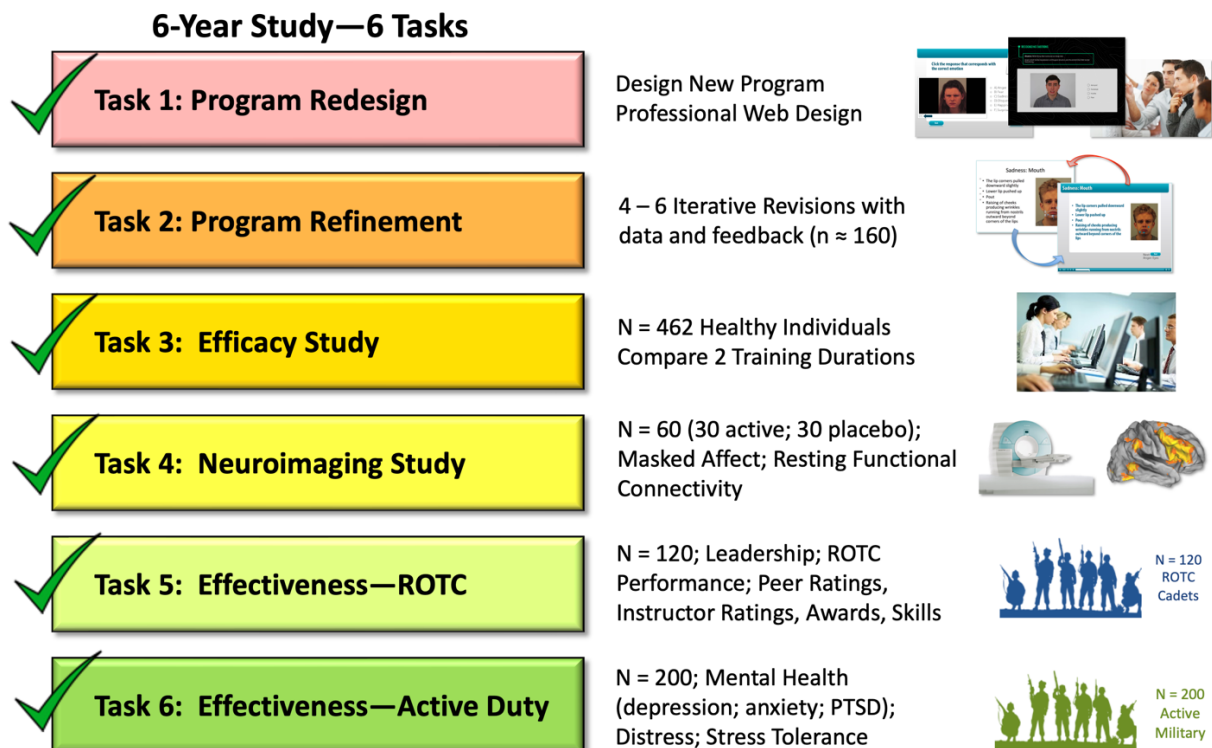
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## 1. INTRODUCTION

The goal of this project is to provide the Army with a brief, well-validated, internet-based training program for enhancing Emotional Intelligence (EI) and resilience skills. Addressing this need is crucial, as military personnel are often required to serve under dangerous and emotionally stressful conditions, oftentimes with limited support from friends and family for prolonged periods of time. Prolonged stress or exposure to intense life-threatening experiences, such as those encountered in combat or other hazardous duty deployments, can increase the risk of developing mental health problems including depression, anxiety, or post-traumatic stress disorder (PTSD). Service members need resilience skills to cope effectively with these stresses. We propose that a critical component to emotional resilience can be built by building strong emotional reasoning skills, also known as Emotional Intelligence (EI). This involves strengthening their emotional flexibility, adaptability, and capacity to cope with adversity before they find themselves faced with such situations. The present investigation aimed to provide the military with a web-based program focused on enhancing EI, a core set of trainable emotional skills that collectively include the capacity to understand, perceive, control, and use emotions effectively to solve problems and reach long-term goals.

The present study comprised 6 sequential Task Projects that were aimed to accomplish of the goal, providing a fully developed and validated program for enhancing EI skills (see **Figure 1**). Task 1 involved fleshing out the details of the proposed EI Training (EIT) program with a group of experts



**Figure 1.** Sequential task projects and projected sample sizes proposed for the project. This project aimed to redesign and refine the program, test the program's efficacy, establish neuromechanisms underlying changes in emotional intelligence (EI) abilities, and establish the program's effectiveness in military contexts. All 6 tasks were accomplished.



in emotional theory and clinical intervention; Task 2 involved web-based design, programming, development, and iterative refinement of the program. Task 3 involved a large efficacy study to determine the overall effects of the program and determining the optimal training schedule for use with the program; Task 4 involved identifying the neural brain changes that occur when participants undergo the optimal version of the program. Task 5 involved testing the effectiveness of the program for enhancing leadership and emotional skills in ROTC cadets. Task 6 involved assessing the effectiveness of the program for minimizing mental health issues in a sample of active-duty military personnel during a stressful experience. All 6 tasks were accomplished, resulting in a fully validated training program for enhancing resilience and EI skills for military personnel.

## **2. KEYWORDS**

Emotional intelligence, affect, training, web-based, resilience, neuroimaging

## **3. ACCOMPLISHMENTS**

### **3A. What were the major goals of the project?**

**Major Task 1:** Retooling of Preliminary EI Training Program (Y1: Q1-3)

Completed: Reconceptualization of the original program was completed and a new set of training materials was developed.

**Major Task 2:** Iterative Refinement of EI Training Program (Y1: Q3-4, Y2: Q1)

Completed: Programing and refinement of the modules was completed.

**Major Task 3:** Efficacy/Training Duration (Y2, Y3, Y4, Y5)

Completed: Data collection for the large-scale efficacy/training duration study was completed. Due to the emerged of the COVID-19 pandemic during the project, this task effort now includes an additional online sample of participants collected during the COVID-19 pandemic to further evaluate the efficacy of using the program in a fully remote form. Six-month follow-up data collection was also completed.

**Major Task 4:** Identify Neuromechanisms (Y2, Y3, Y4, Y5)

Completed: fMRI data collection has been completed.

**Major Task 5:** ROTC Leader Development and Assessment Course (Y2, Y3, Y4, Y5)

Completed: Data collection from ROTC cadets has been collected, including longitudinal outcome measures.

**Major Task 6:** Military Unit Training/Deployment (Y2, Y3, Y4, Y5)

Completed: Data collection for the active-duty military study has been completed.

**Major Task 7:** Process and Analyze Data (Y5, Y6)

Completed: Data have been cleaned and analyzed

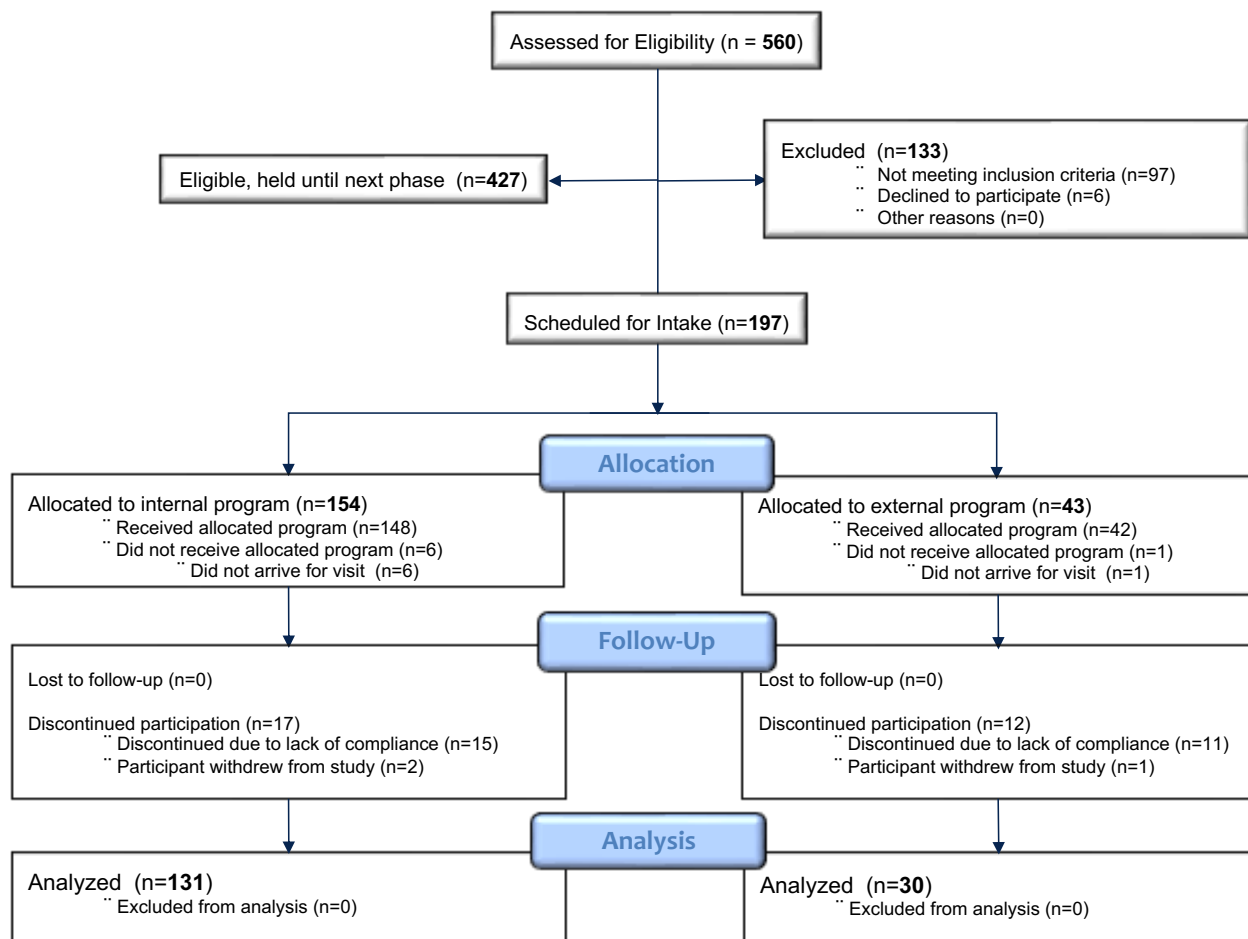
### 3B. What was accomplished under these goals?

#### 1) Major Activities

**Recruitment:** Recruitment for Tasks 1-6 was 100% completed for all tasks. Throughout the study period, recruitment procedures included a number of strategies, including digital media (i.e., Facebook, email listservs), radio, and flyers posted at local businesses, college campuses, and advertisements posted at military installations.

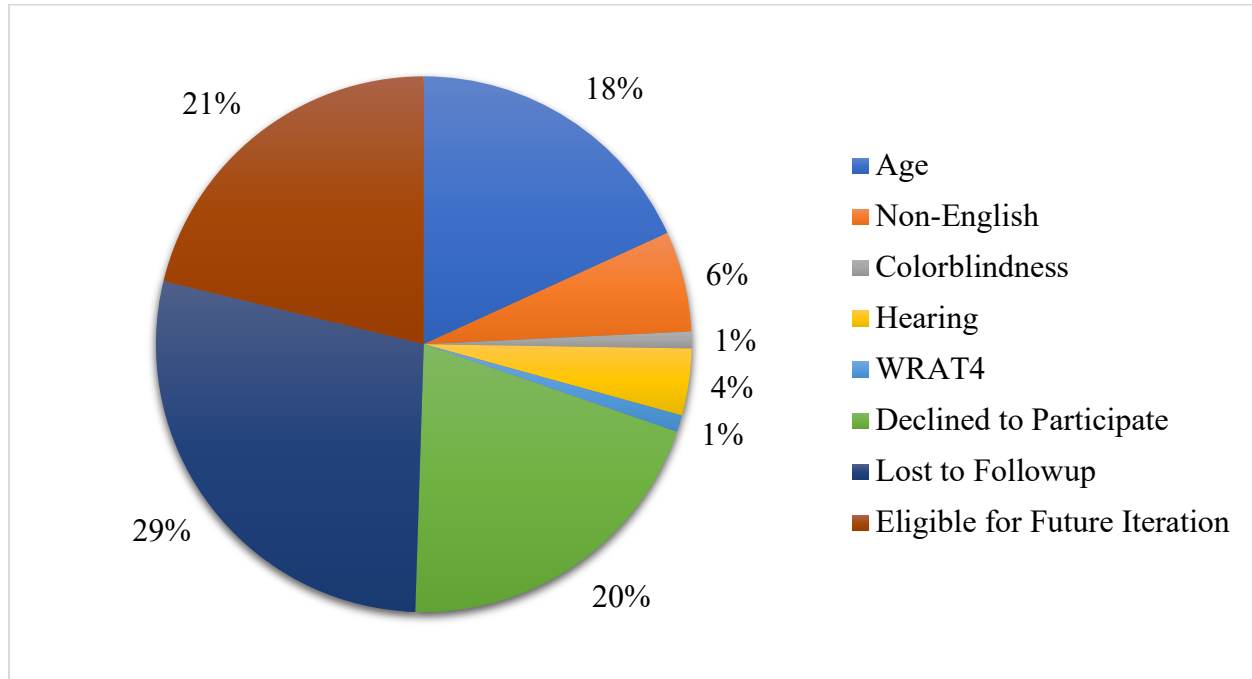
**Task 1:** This task was conceptual in nature and involved a panel of experts who provided suggestions for improving the project. No human research participants were necessary or recruited for the initial redesign stage of EIT program.

**Task 2:** **Figure 2** summarizes the recruitment process for participants included in the Task 2 iterative refinement stage of the EIT program project. Cumulatively, we assessed 560 individuals for eligibility. Of these, 427 were eligible to participate and 133 were not eligible to participate. Of the 427 eligible participants, 197 were enrolled in the project to participate. Of the enrolled participants, 21 did not show up for the initial study visit, 15 were discontinued due to failure to comply with the training schedule, and 161 successfully completed all components of the study.



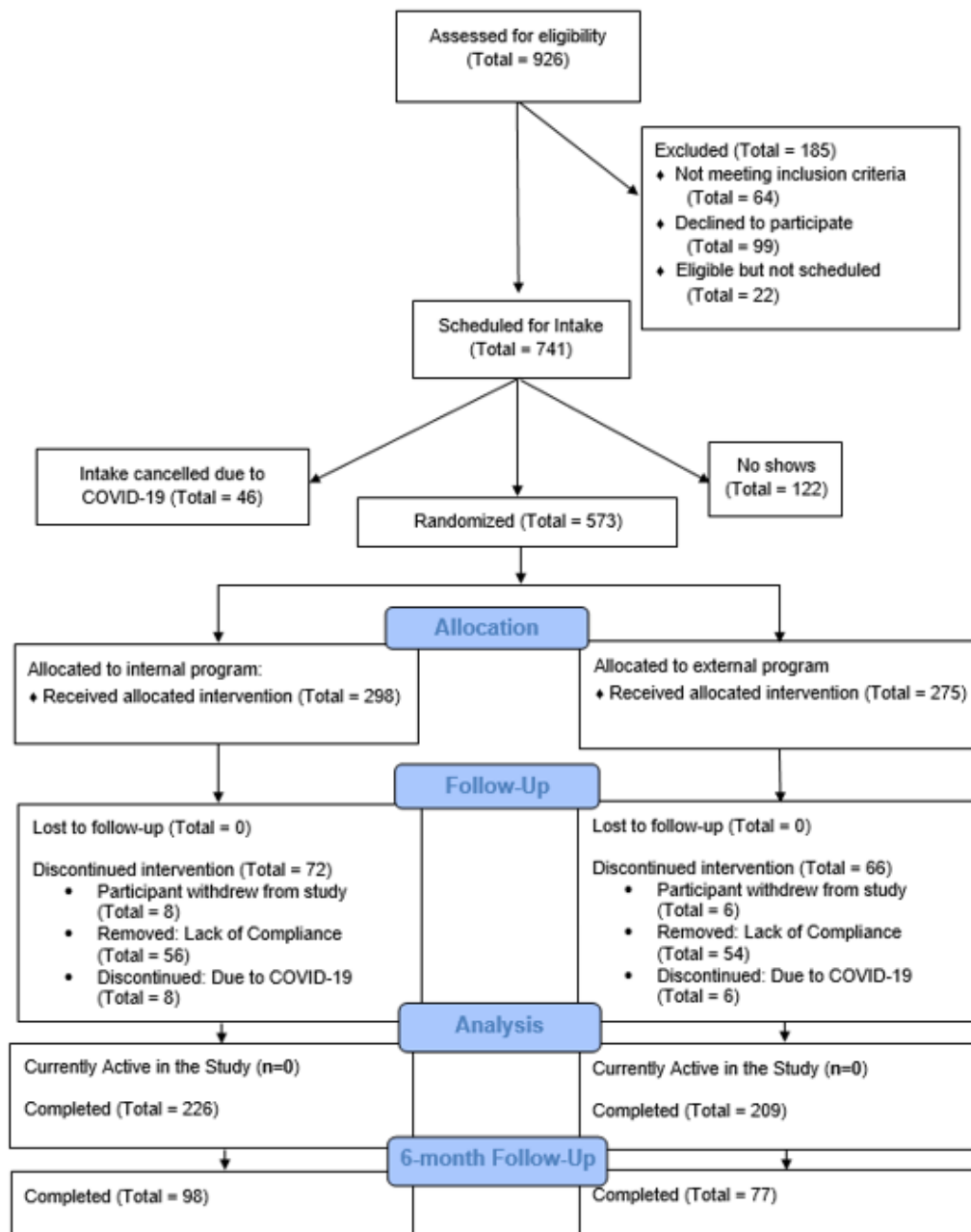
**Figure 2.** Recruitment for Task 2.

The reasons participants were not initially enrolled in the study are summarized in **Figure 3**. A total of 31% were deemed ineligible due to pre-established exclusion criteria: age (18%), colorblindness (1%), hearing (4%), language (6%), and reading ability (1%). The remaining participants were not enrolled in the study because they either expressed that they were no longer interested in the study (20%), were lost to follow-up (28%), or were eligible to be scheduled for a future iteration, but not scheduled for the current task (21%).



**Figure 3.** Breakdown of the reasons for non-enrollment for Task 2.

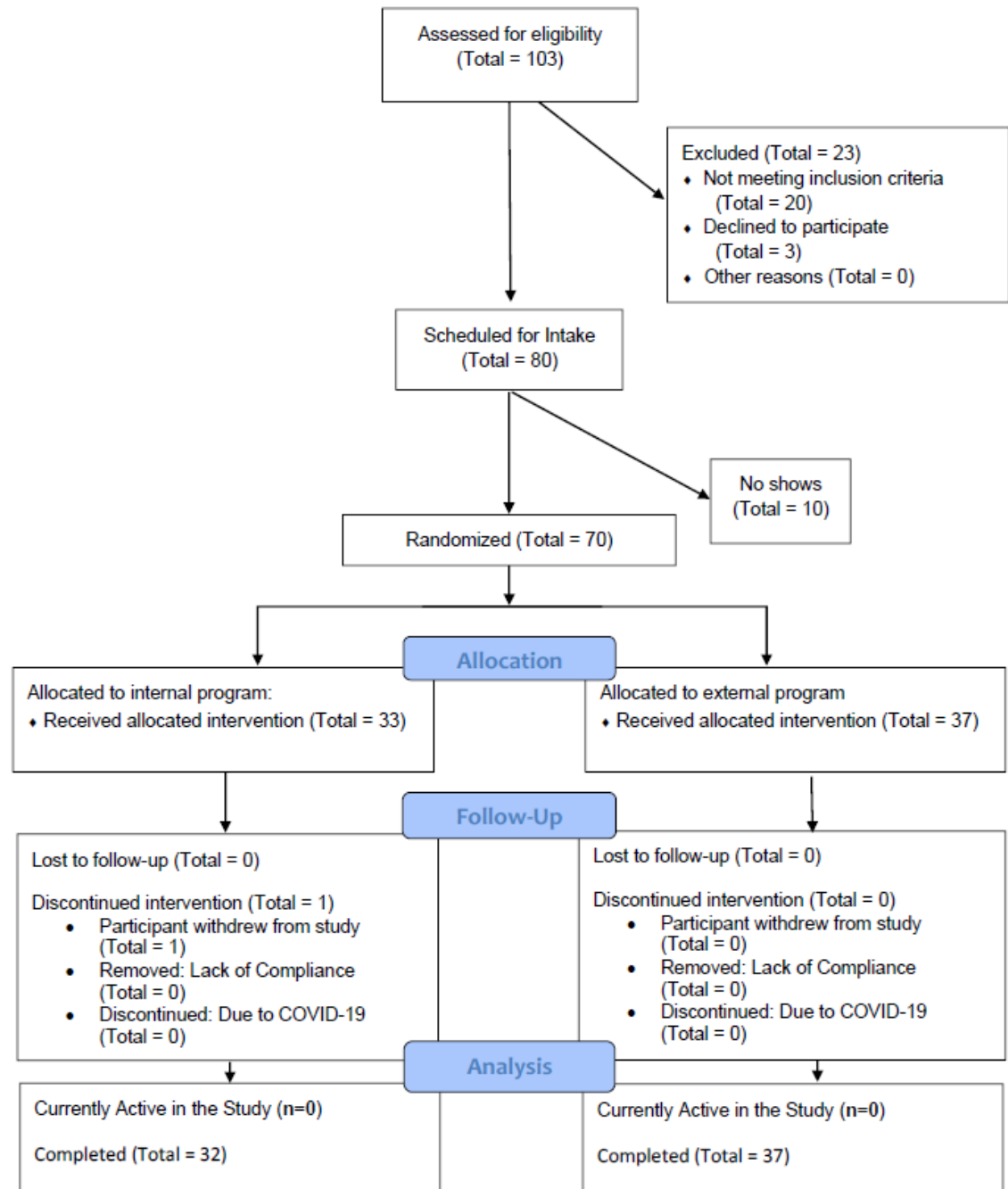
*Task 3.* This task involved administering the completed EIT program to a large sample of individuals from the general population to demonstrate the efficacy of the program. **Figure 4** summarizes the recruitment process for participants included in the primary Task 3 EIT efficacy study. Cumulatively, we assessed 926 participants for eligibility. A total of 64 were excluded due to study criteria, 99 declined to participate, 22 were eligible but not scheduled, and 731 participants were deemed eligible and scheduled to participate. Of the 731 scheduled participants, 122 did not show to the initial visit and 46 had their participation cancelled due to the stoppage of in-person research caused by the COVID-19 pandemic. A total of 573 were randomly assigned to either the active EIT program or the matched Placebo program. A total of 14 participants withdrew from the study, 110 were removed for noncompliance with study protocol, and 14 were discontinued after starting the study due to COVID-19. This resulted in a total of  $n = 435$  participants who completed baseline assessment, training, and post-training assessment sessions, and  $n = 175$  who completed the long-term follow-up session.



**Figure 4.** Consort diagram showing recruitment progress for Task 3.

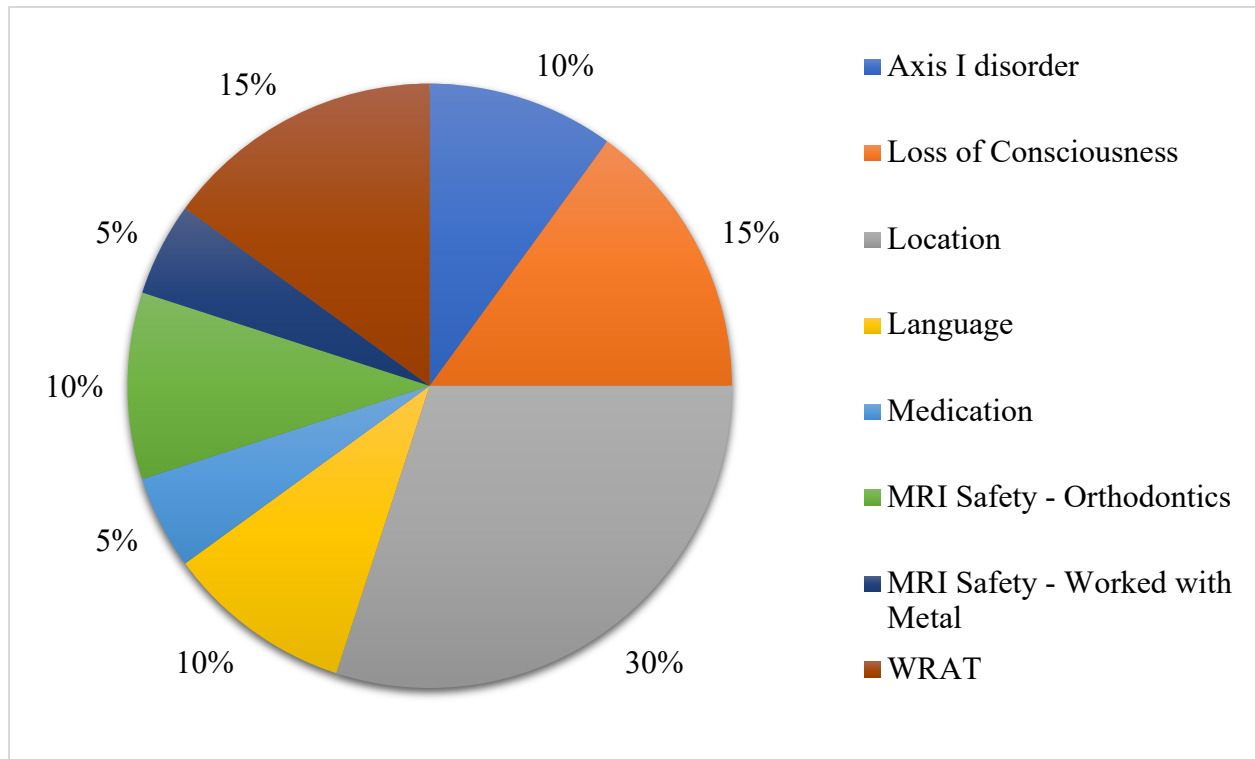
*Task 4.* This task involved validation of the effects of the EIT program on brain functioning using functional neuroimaging. **Figure 5** summarizes the recruitment process for participants included in the neuroimaging study. Cumulatively, we assessed 152 individuals for eligibility. Of these individuals, 103 were deemed eligible for the study, 20 were ineligible due to study restrictions, and 29 declined to participate, and 80 were enrolled to participate. Of the enrolled

participants, 10 did not complete the initial study visit, and 1 participant withdrew during the study, resulting in a total of  $n = 69$  participants who successfully completed all components of the study.



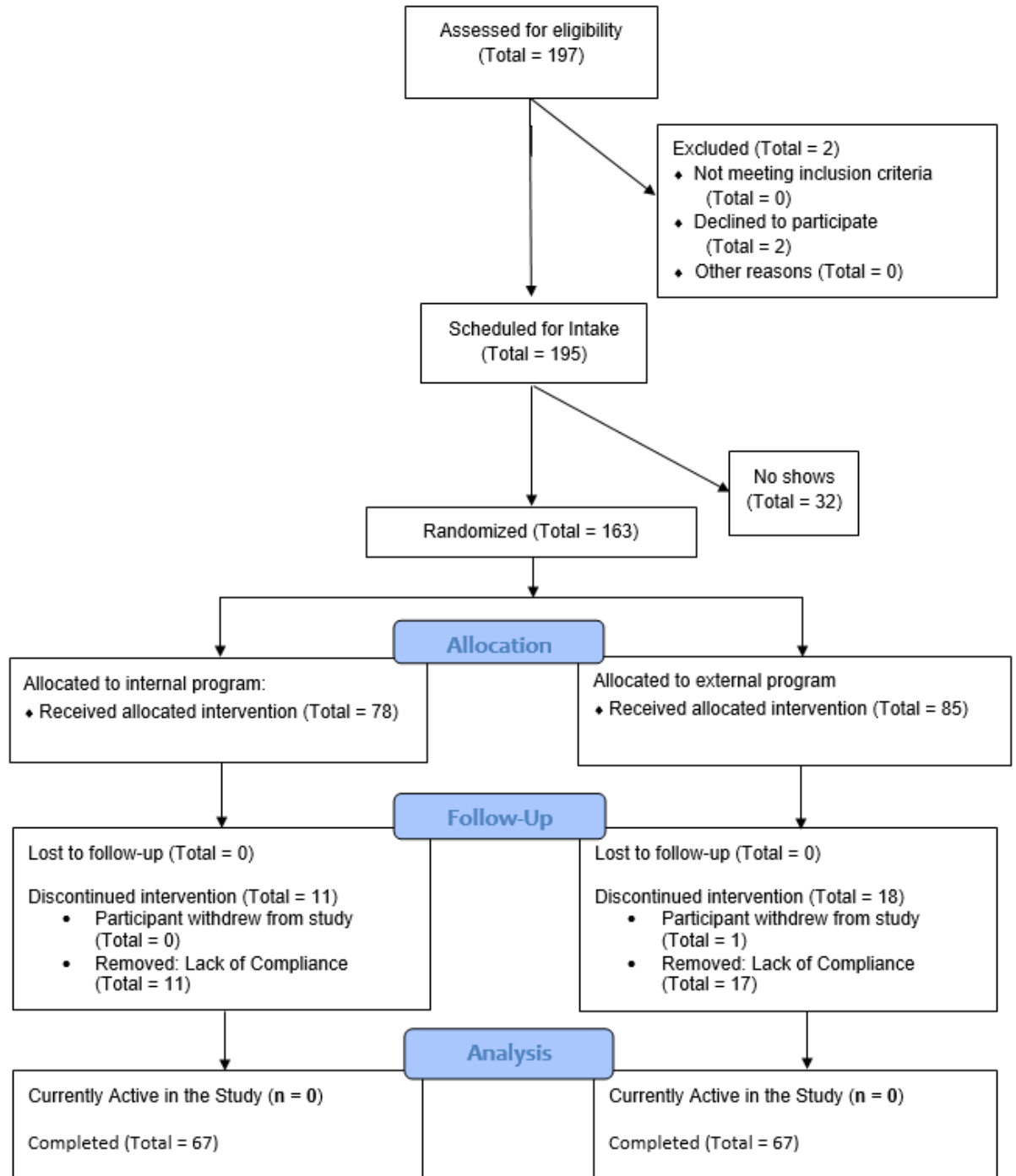
**Figure 5.** Consort diagram showing recruitment progress for Task 4.

The reasons participants were not enrolled in the study are summarized in **Figure 6**. A total of 31% were deemed ineligible due to pre-established exclusion criteria: axis 1 disorder (10%), historical loss of consciousness (15%), inability to attend in-person scans (30%), language (10%) medication (5%), MRI safety – metal in body (15%), and reading level (15%).



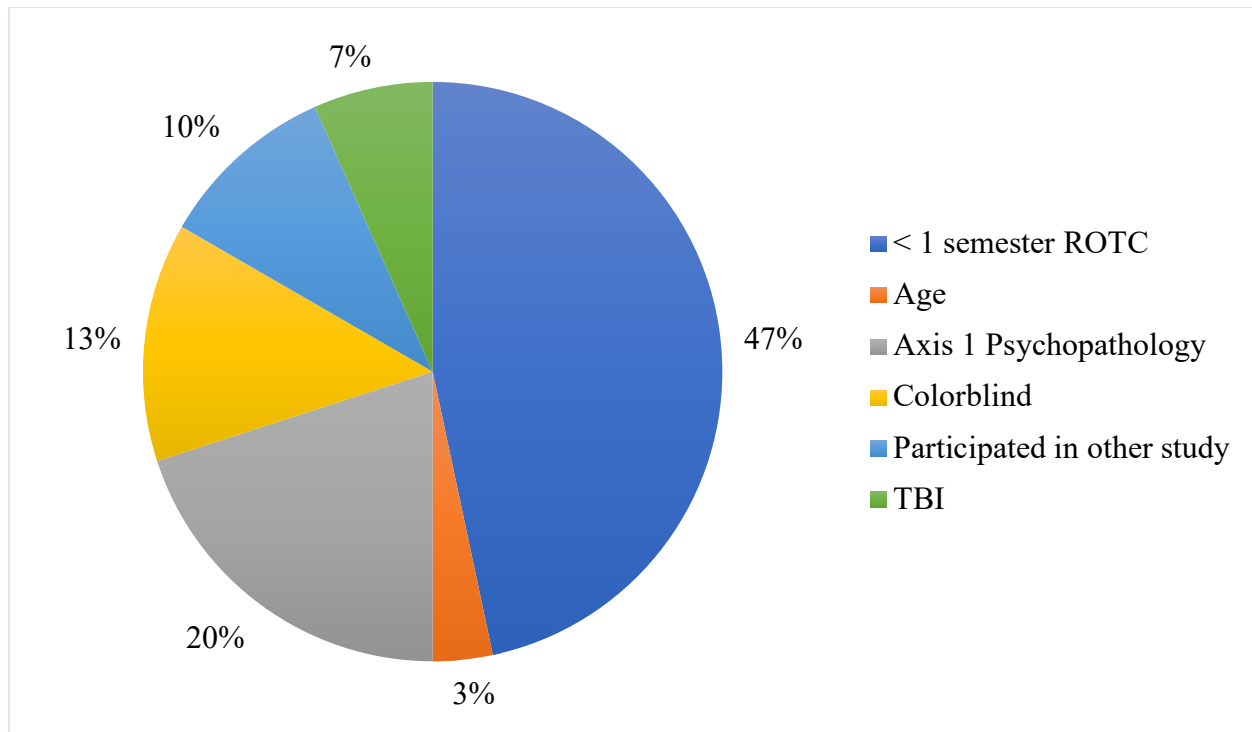
**Figure 6.** Breakdown of the reasons for non-enrollment for Task 4.

*Task 5.* This task focused on the effectiveness of the EIT versus placebo programs on outcomes in ROTC cadets at the University of Arizona and Arizona State University. **Figure 7** summaries the recruitment process for participants included in the ROTC study. A total of 225 ROTC cadets were assessed for eligibility. Of these 225 individuals, 30 were deemed ineligible for the study due to study restrictions, 2 were eligible but declined to participate, and 195 were enrolled in the study. Of the 195 cadets, 32 did not complete the initial study visit, 28 were removed from the study due to poor compliance during the training program, and 1 withdrew from the study. This resulted in a final sample of  $n = 134$  ROTC cadets who completed the baseline assessments, training program, and post-training assessments.



**Figure 7.** Consort diagram showing recruitment progress for Task 5.

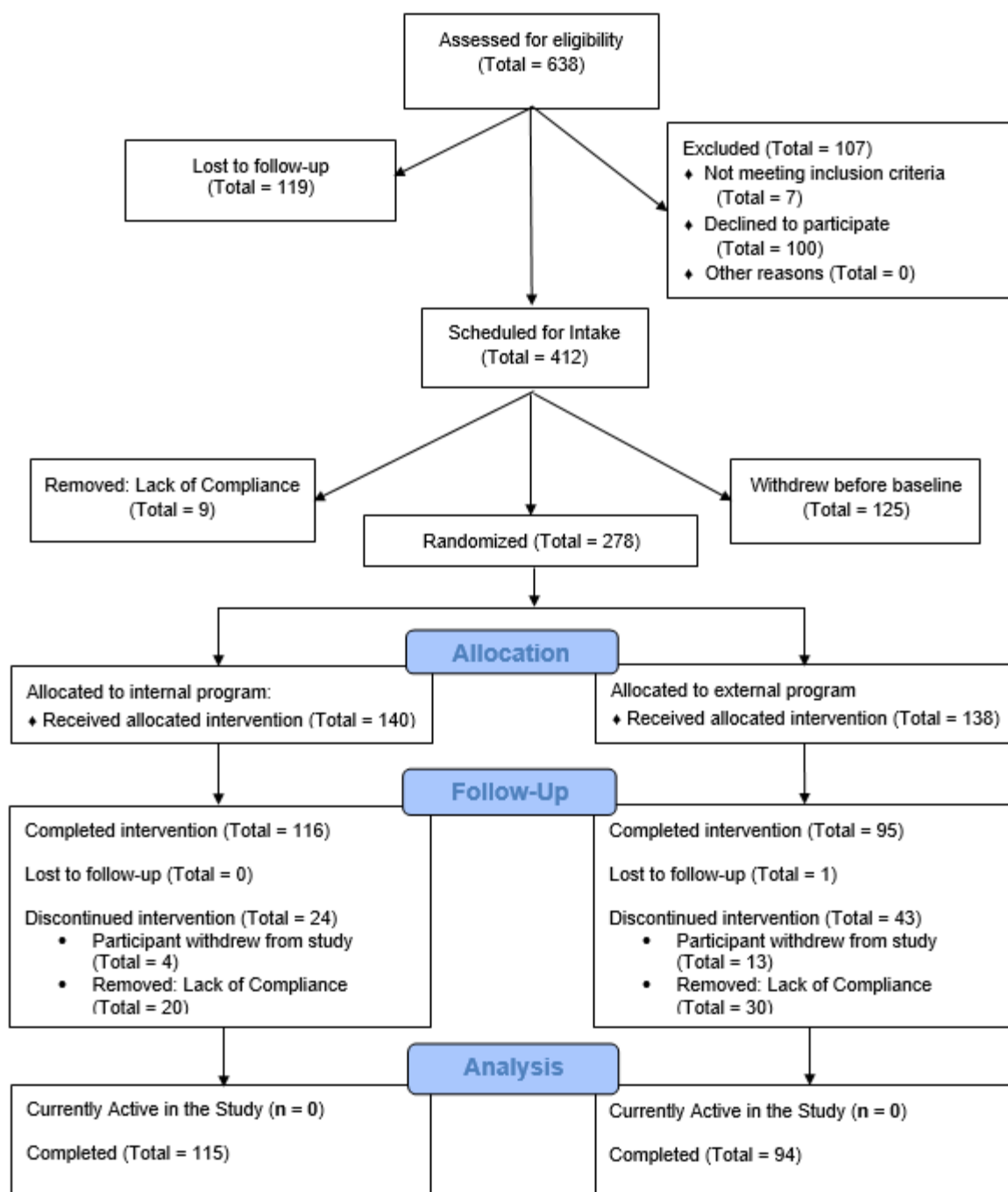
The reasons that ROTC cadets were not enrolled in Task 5 are summarized in **Figure 8**. All ineligible participants were excluded on the basis of not meeting pre-established study criteria: being in ROTC for <1 semester (47%), Age (.3%), colorblindness (13%), participation in another SCAN lab study (10%), Axis 1 psychopathology (20%), or traumatic brain injury (7%).



**Figure 8.** Reasons individuals were not enrolled in Task 6

*Task 6.* This task focused on the effectiveness of the EIT versus placebo program in active-duty military personnel. **Figure 9** summarizes the recruitment process for Service members included in the active-duty military portion of the project. A total of 899 individuals completed an online interest form that automatically screened for eligibility, including active military service status. This process deemed 638 individuals eligible to participate in the study. Of the 638 participants, 412 were enrolled in the study. Of these 412 Service members, 125 did not complete the initial study visit, 9 were removed for lack of compliance with the study protocol, and 278 were randomly assigned to one of the two training program conditions. Of the 278 randomly assigned participants, 2 were lost to follow-up, 50 were removed from the study due to lack of compliance with the study protocol, and 17 participants withdrew voluntarily from the study. This resulted in a final sample of  $n = 209$  active-duty military personnel.

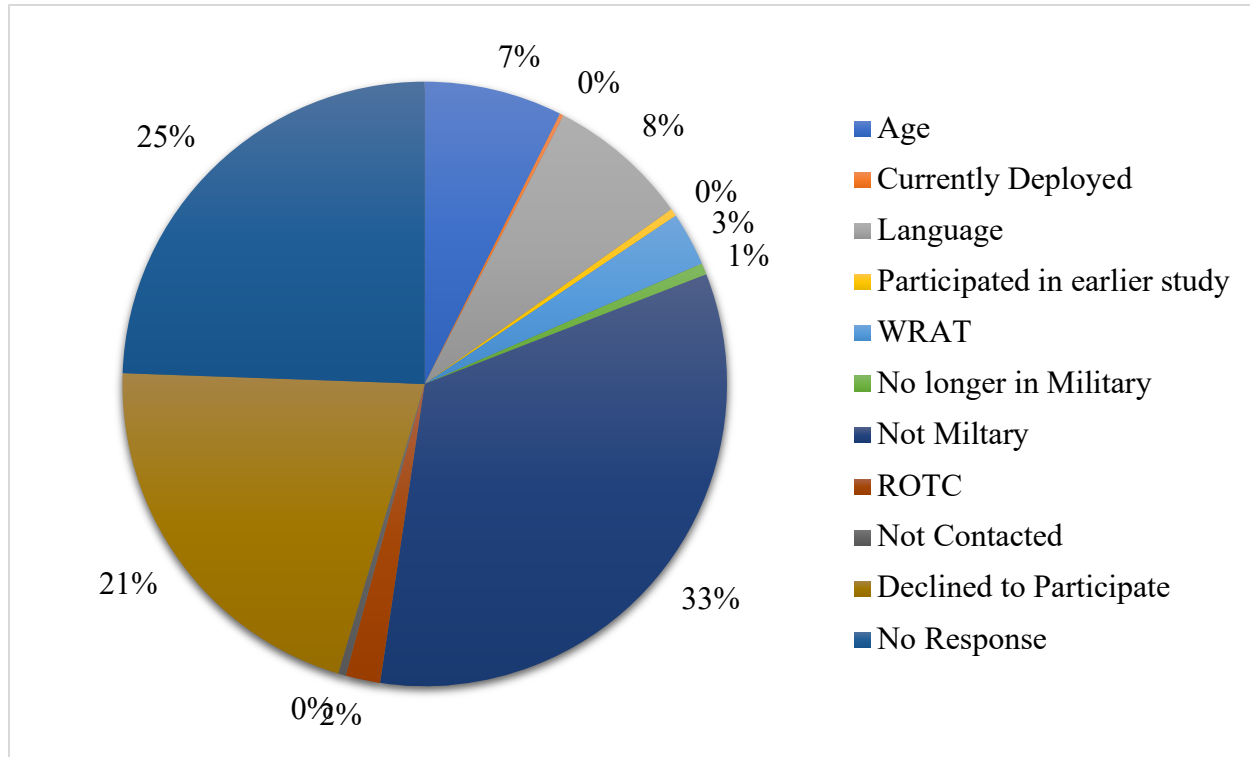




**Figure 9.** Consort diagram showing recruitment progress for Task 6.

The reasons military Service members were not enrolled in the Task 6 study are summarized in **Figure 10**. Over half were excluded on the basis of not meeting pre-established study criteria: age outside of the specified 18-40-year range (7%), current deployment (.2%), language (8%), participation in an earlier phase of the current project (.4%), or reading level (3%). A number of Service members were excluded due to being a member of the ROTC (2%), being discharged from

the military between the time of completing the interest form and starting the study (1%), or not being a Service member (33%). The remaining participants were not enrolled in the study because they never responded to our military status verification request (24%), expressed that they were no longer interested in participating upon follow-up (21%), or were not contacted (.4%).



**Figure 10.** Reasons individuals were not enrolled in Task 6

Data Collection: Task 1 focused only on redesigning and re-programming the EIT and placebo modules, so no data collection was involved. However, Tasks 2-6 involved collection of data. The following is a list of the success in collecting data for each task:

- Data collection is 100% complete for Task 2 (N = 161 subjects)
- Data collection is 100% complete for Task 3 (N = 435 subjects)
- Data collection is 100% complete for Task 4 (N = 69 subjects)
- Data collection is 100% complete for Task 5 (N = 134 subjects)
- Data collection is 100% complete for Task 6 (N = 209 subjects)
- In total, **1,008** subjects completed the project and provided data.

Data Management: The following standard data management procedures were followed:

- Study staff uploaded and stored study data in REDcap, a HIPAA compliant digital storage database and our secure internal server.
- Data for all tasks were reviewed for quality and accuracy

Statistical Analyses: The following general approaches to statistical analysis were followed:

- *Behavioral data*: data were imported to IBM SPSS v. 28 for statistical analyses.
- *Neuroimaging data*: Multimodal imaging data included high-resolution anatomical scans (T1 weighted MPRAGE), diffusion tensor imaging (DTI), and resting state functional connectivity (FC). Imaging data were analyzed using SPM, CONN, FSL, and TBSS.

## 2) Specific Objectives:

The stated objectives, Specific Aims, and hypotheses from the initial project proposal are as follows:

The *overall objective* in this proposal is to develop a brief web-based training program to quickly and robustly enhance emotional resilience and life skills in warfighters by identifying the key components that contribute to emotional intelligence (EI) and targeting the enhancement of those specific skills. Based on our prior research into the neurobiological basis of EI and our preliminary data demonstrating malleability of these skills through training, our *central hypothesis* is that a set of well-designed and targeted training modules addressing four core emotional ability domains will significantly enhance measured EI skills, will translate into improved performance on militarily relevant metrics, and will lead to better emotional health and wellbeing during stressful situations and subsequent cognitive processing. The *rationale* that underlies the proposed research is that a successful web-based EI training program will provide a widely accessible, brief, and effective method for enhancing resilience against trauma and promote general wellbeing for Service members and their families. This will be accomplished through six primary tasks encompassed within the following three specific aims:

***Specific Aim #1: Identify key training components (i.e., content, frequency, duration, number of lessons) that lead to the greatest improvement in measured EI skills across all four domains.***

Hypothesis 1. The EI Training Program will produce significantly greater enhancement of EI scores than a matched Placebo Training Program, regardless of training duration.

Hypothesis 2. We hypothesize equivalence (or non-inferiority) among the three administration durations, which would argue in favor of using a shorter administration time without loss of efficacy.

Hypothesis 3. It is hypothesized that the changes in EI scores observed at the immediate post-training assessment will be sustained at 6-month follow-up for the subsample providing such assessments.

***Specific Aim #2: Identify the neural mechanisms underlying the observed changes in EI abilities***

Hypothesis 1. During emotional processing of masked faces on the MAT, changes in functional activation of the emotion responsive circuitry (i.e., vmPFC, amygdala, insular cortex, ACC) will be positively correlated with improvements in EI scores.

Hypothesis 2. It is also hypothesized that treatment-induced increases in EI will be correlated with increases in the inverse functional connectivity between the vmPFC and amygdala (i.e., greater emotional inhibitory capacity).

Hypothesis 3. Based on our preliminary data, we hypothesize that increased EI will be associated with the strength of functional connectivity among brain networks involved in affective regulation, emotional experience, self-reflective processing/theory of mind (TOM), and reward-based learning.

***Specific Aim #3: Determine the effectiveness of the EI training program for enhancing military performance and sustaining psychological health during stressful military operations/activities/deployments***

Hypothesis 1. The optimized EI Training Program will produce significantly greater enhancement of measured EI, resilience, Grit, coping capacity, and emotional wellbeing than a matched Placebo Training Program by the end of an ROTC leader development and assessment course (LDAC).

Hypothesis 2. The optimized EI Training Program will yield significantly lower weekly PSS scores and increase HRV (mean and slope) during the course of LDAC than the matched Placebo Training Program.

Hypothesis 1. The optimized EI Training Program will produce significantly greater sustainment of mental health (PTSD symptoms; depression; distress; psychopathology symptoms) and enhancement of EI scores, resilience scores, and Grit scores than a matched Placebo Training Program during a hazardous deployment (or stressful FTX).

Hypothesis 2. The optimized EI Training Program will yield significantly lower PSS scores and higher HRV (mean and slope) following deployment (or FTX) than the matched Placebo Training Program.

### 3) Significant Outcomes/Key Results

In the following sections, the report will address each of the six individual project tasks (i.e., Tasks 1-6) separately. Each section will provide a brief overview of the specific task rationale and activities and the outcomes that emerged from that task, including statistical analyses.

#### 3.1 TASK 1: Retooling of the Preliminary EIT Program

**Overview:** As part of a previously funded project (W81XWH-09-1-0730), we had developed and validated a pilot version of an EI training program. That pilot version was based on the four-branch model of EI proposed by Mayer, Salovey, and Caruso (Mayer et al., 2002), which suggests that EI can be assessed using various “ability” metrics that include the abilities to Perceive emotions, Understand emotions, Facilitate thought, and Manage emotions. These are conceptualized as “abilities” that can be measured through objective testing rather than through subjective perceptions of one’s traits. The training in our initial program included six lessons targeting the following topics: 1) an introductory to EI and the program, 2) emotional perception, 3) understanding emotions, 3) using emotions, 5) managing emotions, and 6) reviewing the lessons learned in the training. After developing the training materials and programming them into an online administration system, we conducted a preliminary validation and efficacy study, comparing the EI training to a closely matched placebo training condition. As described in Alkozei et al., (Alkozei et al., 2019), in the initial pilot study, 59 participants were randomly assigned to receive the EI training ( $n = 29$ ) or the placebo training ( $n = 30$ ). Alkozei et al. (2019) found that the individuals in the EI training group showed an increase in their total MSCEIT scores relative to those in the placebo training group,  $F(1, 55) = 4.36$   $p = .04$ . In addition, participants in the EI training showed significant increases to their perceiving emotion,  $F(1, 55) = 4.65$ ,  $p = .04$ , and using emotions to facilitate thought,  $F(1, 55) = 21.54$ ,  $p < .001$ , relative to the placebo control. That successful demonstration suggested that it is possible to train some specific EI skills rapidly using an online training approach.

Based on the preliminary data collected during our pilot study, the initial version of the EI training program was found to produce significant improvement in EI scores for two of the four branches of the MSCEIT (i.e., Perceiving Emotions; Facilitating Thought). However, the other two branches (Understanding Emotions; Managing Emotions) were not significantly improved in the pilot study.

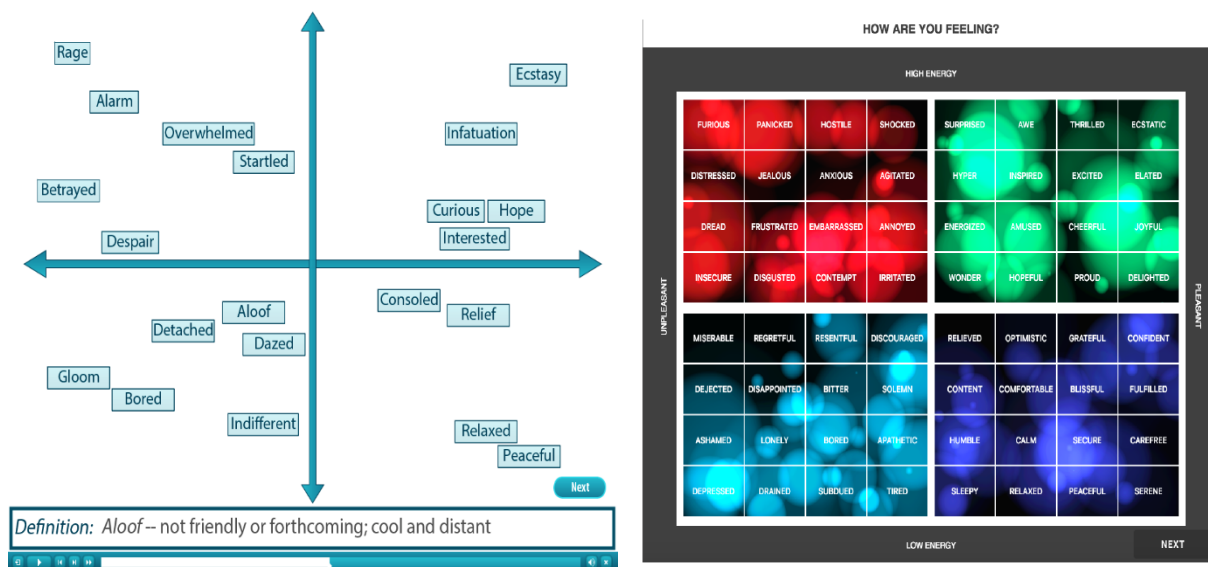
Therefore, the initial task of this much larger project was to critically re-evaluate the existing content and format of the pilot training modules and make substantive improvements that address weaknesses in the pilot program and capitalize on its existing strengths. In the present study, this was addressed by *Specific Aim #1: Identify key training components (i.e., content, frequency, duration, number of lessons) that lead to the greatest improvement in measured EI skills across all four domains*

**Methods and Outcomes:** A panel of three experts in the fields of emotion theory, clinical psychology, and health outcomes, all at the rank of full professor, who were not affiliated with the initial development of the program, worked closely with the PI to critically evaluate the six existing

pilot training modules and the data from the preliminary study. This panel, along with the PI, focused on eliminating ineffective content and replacing it with stronger, empirically and theoretically supported content. Moreover, panel members contributed additional ideas for potential new modules. The entire panel assessed the full complement of ideas and recommended a final set of changes to improve upon the current version of the program.

At that time, the University of Arizona (UA) also contracted with an educational development programming company, Smart Sparrow, to repackage the redesigned content of the program into a more sophisticated format. As part of this process, Smart Sparrow conducted user interviews, content research, and market research, and surveyed the competitive landscape for similar products. This information, paired with the recommendations from the expert panel, resulted in a number of changes to the program, as described below:

**Enhanced Graphic Design:** The pilot EIT program was presented in a PowerPoint-like format. Material was often presented in a bulleted list, supplemented with stock images and basic graphics. The experts, user interviews, and market research all identified this as a major focus area for improvement. We worked closely with the programming company, Smart Sparrow, to identify areas in which the graphic design of the program could be improved. In particular, the new version was aimed toward military audiences, so it was updated with a more videogame like background and feel, and we included extensive use of military images. Major changes included updating the color scheme, replacing stock photos and cartoons with more sophisticated images, and breaking up text blocks with pictures, charts, and interactive activities. See **Figure 10** below for a comparison of the pilot and redesigned EIT programs.



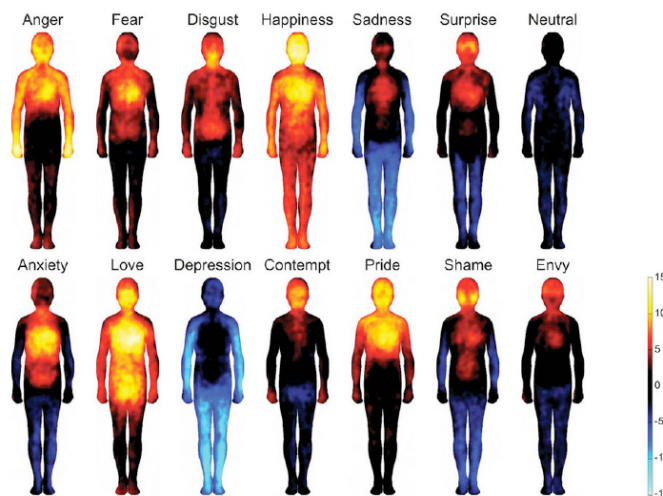
**Figure 10.** The pilot emotion grid (left) and the retooled emotion grid (right). The emotion grid taught students to categorize emotions by valence and arousal, and students could hover over an emotion to learn its specific definition. The retooled emotion grid included more emotion words, introduced a color scheme, and had a more sophisticated appearance.

**Ineffective Components:** The experts identified several content areas they considered irrelevant to the program focus. For example, the facilitating emotion module contained a lengthy section for

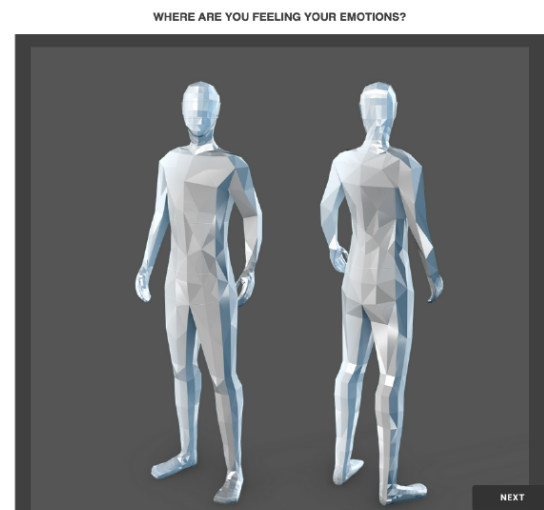
categorizing non-emotion words (e.g., “blanket”) in terms of their valence and arousal. The new version focused solely on categorizing emotion words and incorporated greater information about how to use emotions. The experts also identified several areas in which the content was repetitive. Although practice and repetition have been shown to help with learning, some of the redundancy could be excessive, leading one participant in the pilot study to comment *“it’s condescending/patronizing. So many times, I was thinking “yes, ok, I got it. I’m not in junior high.”* For example, the perceiving emotion module taught participants how to recognize emotions through facial features, and the bulk of the lesson was a lengthy test of the participants’ ability to recognize these emotional expressions in 48 videos. The conclusion module also repeated information from the previous modules verbatim. The new version emphasized greater subtlety in reiterating information and reducing number of application questions to a more tolerable level.

**User Engagement:** The pilot program contained some interactive elements (e.g., videos, questions, drag and drop, etc.), but the user interviews and market research identified this as a target area for improvement. The retooled version focused on increasing interactive and gamified features (videos, drag and drop, hover, free response, drop down, active problem-solving, etc.). For example, we developed an emotional sensitivity training activity based on research concerning the body sensations of specific emotions (Nummenmaa et al., 2013). In this activity participants were asked to color on a body map to indicate the location and degree of physiological changes experienced when feeling an emotion. This Body Map Tool was presented at multiple points throughout the program and allowed the user to self-explore their own emotional state and link it to specific somatic sensations. The goal was to train the individual to become more aware of the subtleties in somatic sensations that correlate with specific emotions (see **Figure 11**).

#### Empirical Data for Body Emotion Sensations



#### Prototype Body Map Tool



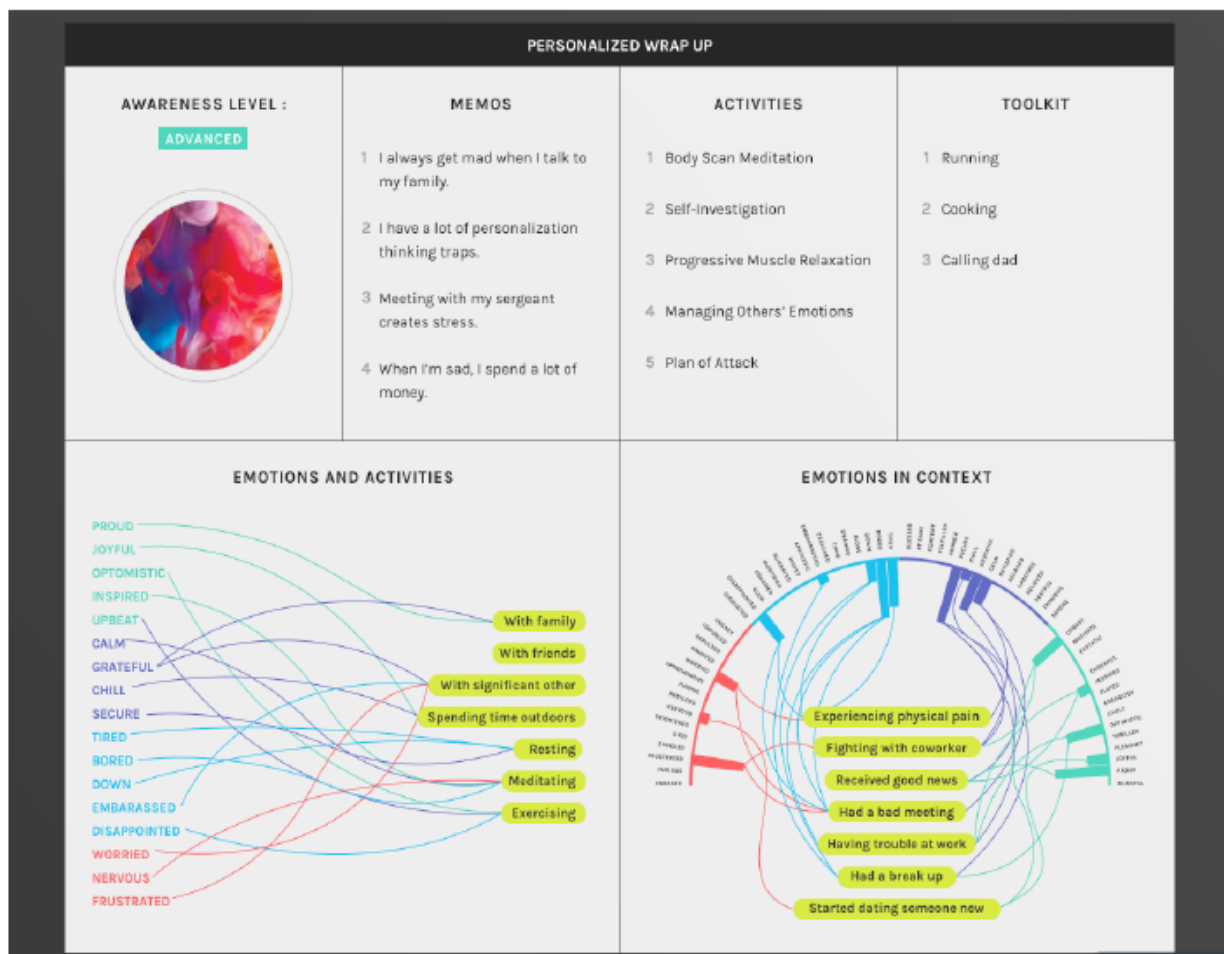
**Figure 11.** The prototype body map tool. Students learn about normative body emotion sensations from Nummenmaa et al. (2013). Throughout the training, students draw on the body map tool to indicate the location and intensity of their bodily emotional sensations.

The retooled program was also organized in a tiered structure to convey the sense of “leveling up” as participants moved from learning basic concepts to complex emotional skills. The user was



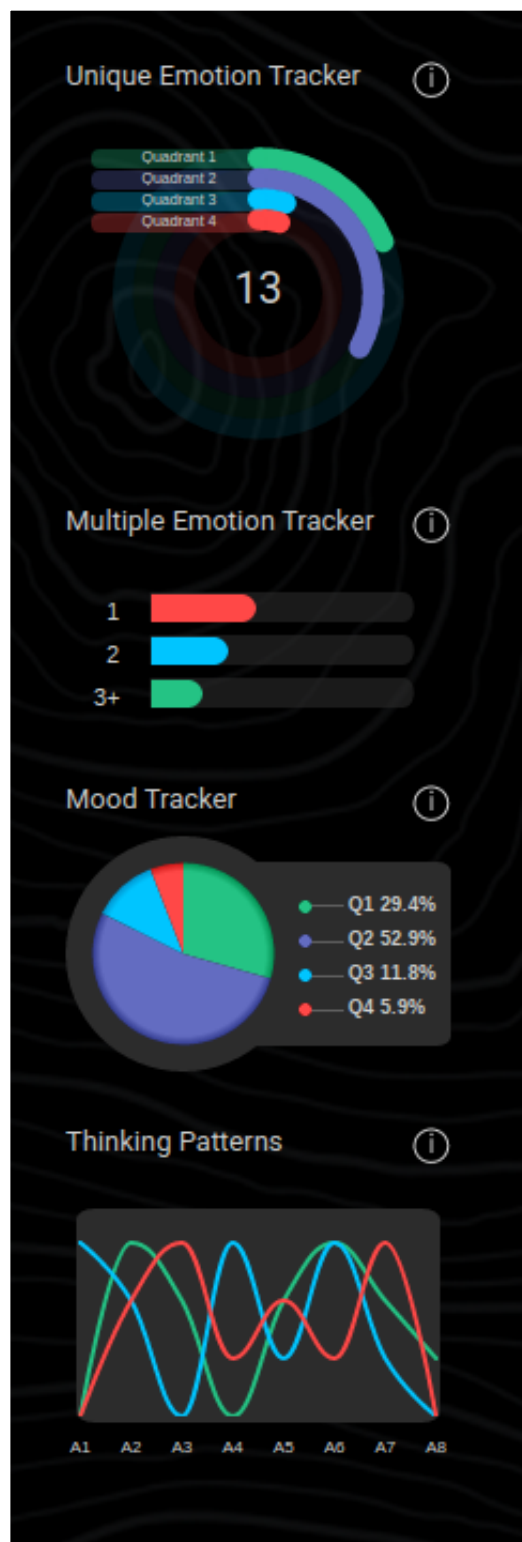
systematically taken through three “tiers” of training. Initially, training began with a set of four introductory lessons. The user was also able to choose the order among the lessons within each tier so that they could personalize their experience to some degree to ensure they maintained engagement in the training activities. Eventually, they would complete all lessons, but this added flexibility was expected improve the overall user experience. After completing the Tier 1 introductory lessons, the participant would “graduate” to Tier 2, which focused on the development of specific social and emotional skills. Once these skills had been mastered, the user would then be permitted to complete the final Tier 3 lessons. The final set of lessons utilized adaptive learning technologies and incorporated information entered in earlier lessons to tailor the last training experiences to the specific needs of each user.

The interviews and market research also found that participants felt more engaged when the information was personally relevant and connected to the “real world”. Accordingly, the retooled version added features to increase self-relevance with greater opportunities for application and self-reflection. This was accomplished though incorporating more free-response opportunities and by using sophisticated programming that allowed us to carry user inputs throughout the lesson (see **Figure 12**). For instance, participants could type in a personally relevant goal, and then later in the



**Figure 12.** Prototype of the personalized summary module designed to help students identify patterns and self-reflect on emotion-related tendencies.





**Figure 13.** The EIT program also included an “emotional fitness tracker” to monitor progress through the program and to identify areas for further development.

lesson, they would be asked to reflect on how EI would help them accomplish their specific goal. The retooled version also highlighted the relevance of the training content by using real-world examples and by showing how the information could be used to solve interpersonal and intrapersonal problems. As shown in Figure 12, the participant had a personalized wrap up of their own areas for growth at the end of the training.

Another core development was the emotion fitness tracker exercise (see **Figure 13**). The tracker would allow the participant to monitor their progress through the training modules and identify strengths and weaknesses. Throughout the program, participants would indicate a situation they had recently experienced, their interpretation of the situation, the emotions and bodily reactions they experienced, their action tendencies, and their behaviors in response to the situation. At the end of the training program, participants received a tailored summary of their emotion tracker responses that allowed them to identify patterns and self-reflect on their responses. This exercise promotes recognition, understanding, and awareness of their own emotions, and the potential causes and consequences of those reactions.

**Expanded EI Content:** The initial pilot EIT program we had developed prior to this project was based on the Mayer-Salovey-Caruso Emotional Intelligence model (MSCEIT), and closely followed the MSCEIT model in terms of program content. However, the pilot program was somewhat limited by time constraints, and the experts thought it would be beneficial to expand the content and training lessons for each of the four branches of EI posited by the MSCEIT model as described below:

*Perceiving emotions.* The pilot module for perceiving emotions only focused on perceiving emotions through the facial expressions of others. The new program added information perceiving one’s own emotions through bodily awareness. It also expanded the *perceiving the emotions of others* lesson to discuss facial, vocal, body, and situational cues. Thus, the revised version now includes a more comprehensive coverage of emotional perception skills.

*Understanding emotions.* The pilot lesson for understanding emotions taught students about emotional language, valence and arousal, emotional blends, and emotional transitions. The new version kept this information and added greater content about understanding relationships between situations, interpretations, emotions, bodily reactions, action tendencies, and behaviors. As shown in **Figure 14**, participants learned to incorporate common concepts like the Emotion Reaction Cycle to their own life circumstances.



**Figure 14.** Prototype of the reaction cycle. Students learn about the reaction cycle and then use this model to track their emotions throughout the training

*Using emotions.* The pilot lesson for using emotions had a brief lesson on how mood can help or harm goal-directed behavior. The new version expanded this lesson to focus on the functions of each of the basic emotions. It also included a lesson about goal setting and how emotional intelligence can help participants accomplish their personal goals.

*Managing emotions.* The pilot version of the training introduced three key emotion regulation techniques: problem-solving, cognitive reappraisal, and mindfulness. The retooled version spent more time on teaching emotion regulation strategies. It also expanded the mindfulness content into its own lesson, including breathing exercises, practice, and more details on the nonjudgment and non-reactivity aspect of mindfulness. Finally, the new program added a social skills lesson focused on managing the emotions of others.

**Incorporating Broader Emotion Research:** As previously mentioned, the pilot EIT program closely followed the MSCEIT model of EI and only focused on teaching individuals about perceiving, using, understanding, and managing emotions. Due to the program’s intended purpose of increasing resilience and protecting mental health, the experts believed that the program would be strengthened by incorporating clinical perspectives on emotional skills as well. Therefore, the new program was expanded beyond the four branches of EI to also include emotional skills taught in effective psychotherapies such as cognitive behavioral therapy (CBT), acceptance and commitment therapy, and mindfulness-based stress reduction. Such skills included recognizing and challenging cognitive distortions, understanding emotion-driven and avoidance behavior, and practicing non-judgmental acceptance of thoughts and emotions.

**The Retooled Program:** As outlined above, the retooling phase resulted in a thorough re-evaluation of the content of the pilot EIT program by several experts in emotion theory and clinical psychology. Weak content was replaced, existing content was strengthened, and relevant content outside the specific MSCEIT model of EI was added. Modules were also re-designed and re-programmed to be even more visually appealing with clearly articulated content.

At the end of this retooling phase, we had a clear and articulated idea of what the new program should include. The EIT program was to be a web-based program with highly interactive activities that would require participants to engage with and practice the presented concepts. This program would cover seven major training domains, including 1) Foundational Knowledge of Emotions, 2) Knowing One's Own Emotions, 3) Motivation, 4) Managing Emotions, 5) Knowing others' Emotions, 6) Managing Others' Emotions; and 7) Empathy. Detailed descriptions of the EIT program goals and objectives are provided in the table below (**Table 1**).

The program was designed such that training content would be presented through individual modules and organized into three progressive tiers to be completed in linear order. Tier 1 would focus on introducing the program, familiarizing the student with program mechanics, and teaching the student about basic emotional processes. Next, Tier 2 would introduce the student to core EI concepts and related emotional skills, including mindfulness, cognitive distortions, recognizing emotion, and managing emotions. Finally, Tier 3 would dive deeper into specific content areas and provides the student with greater opportunities for practice and self-reflection.

**Table 1.** Content Summary for the Emotional Intelligence Training (EIT) Program.

Overarching Program Goal	Objective(s)
Foundational Knowledge of Emotions	Describe the function and value of experiencing emotions Explain the physiological underpinnings of emotion Discuss how context informs emotional response
Knowing one's own emotions	Differentiate emotions within the emotional dictionary Recognize and label their own emotions
Motivation	Remember the potential benefits (interpersonal) of the ability to regulate emotions Remember the potential difficulties due to the inability to regulate emotions
Managing Emotions	Demonstrate motivation for practice in mindfulness Recall the components of mindfulness Identify own cognitive distortions Reframe cognitive distortions Recognize the state of mind from which an individual is acting Identify different types of emotion avoidance strategies they use Understand the consequences of emotion avoidance Identify Emotion Driven Behaviors (EDBs) in their life Plan counter behaviors to EDBs
Knowing others' emotions	Interpret others' emotions with awareness toward own biases
Managing others' emotions	Identify the most adaptive and effective reaction for changing another person's emotions

	Describe the value of positively changing another person's emotions
Empathy	Demonstrate empathetic responses Demonstrate motivation to practice empathy

**Task 1 Conclusion:** For the first year of the project, the initial task (i.e., Task 1) was to refine and strengthen the existing pilot EIT program that had been previously developed in a prior study. Through an extensive and painstaking process that included expert panels, critical revaluation of materials, focus groups, and literature review, we were able to identify areas of weakness in the initial program and direct new efforts to increase theoretical and empirical content. In close collaboration with the design team at Smart Sparrow, this new content was designed into an initial set of engaging training tasks on a more sophisticated computer presentation platform. These efforts yielded a conceptually stronger and potentially more robust package of treatment modules to assess and refine during the next stage of development (Task 2).

### 3.2 TASK 2: Iterative Refinement of the EIT program

**Overview:** In task 1, a thorough critical evaluation of the pilot EIT program identified several areas for improvement and redesign. Based on that work, we developed a revised and significantly expanded set of content for the retooled EIT program and worked with our programming firm, Smart Sparrow, to reprogram it into a sophisticated web-based training program. The next step was then to refine the EIT program until it reached its most effective and error-free final form. We completed this refinement in two cycles over a period of two quarters. The first cycle ( $n = 40$ ) was an initial test of how participants reacted to the practice exercises that were intended to be added to the revised program. This iteration was done to inform the design of the overall program. After the program had been fully designed and programmed, we then administered the program to a second cycle of participants. This second cycle ( $n = 136$ ) was a more thorough test of the EIT program. Participants took the EIT program and then completed a detailed user experience survey after each module. We used participants' responses to carefully refine the program. At this time, we also developed a matched placebo training program to use as a control condition. This study was designed to address *Specific Aim #1: Identify key training components (i.e., content, frequency, duration, number of lessons) that lead to the greatest improvement in measured EI skills across all four domains.*

**Sample Description:** Participants were recruited from the University of Arizona and the surrounding Tucson metropolitan area. Participants were recruited through flyers, listserv emails, and advertisements in newspapers, Facebook, and Instagram. A total of  $n = 40$  participated in the first cycle and  $n = 136$  participated in the second cycle. Sample characteristics are described in **Table 2**.

**Table 2**  
*Characteristics of Participants in Cycle 1 and Cycle 2 of Task 2*

	<b>Cycle 1</b> <b><math>n = 40</math></b>	<b>Cycle 2</b> <b><math>n = 136</math></b>
<b>Age</b>	22.23 (SD = 3.42)	23.13 (4.79)
<b>Gender</b>		
Male	42%	37%
Female	58%	63%
<b>Ethnicity</b>		
White	58%	55%
Black or African American	5%	4%
Native American or Alaska Native	0%	NA
Latino or Hispanic	20%	20%
Asian	8%	12%
Other	10%	NA
Missing	NA	9%

Note: Some participants from Cycle 2 were missing demographic information

**Cycle 1 Methods and Results:** We conducted an initial test run with participants to determine the most effective frequency of practice exercises. We specifically tested the frequency of meditative practices within a mindfulness lesson. We had four experimental groups with 10 participants each. Each module contained the same content, focusing on 1) introducing mindfulness, 2) the “present awareness” aspect of mindfulness, and 3) the “nonjudgmental” aspect of mindfulness. However, the modules differed intentionally in the number and type of mindfulness mediation practices included in the lessons as follows: Group 1 completed a guided breathing exercise; Group 2 completed a guided breathing exercise and a guided breathing exercise paired with scaffolding; Group 3 completed a guided breathing exercise, a guided breathing exercise with scaffolding, and a non-guided mediation; and Group 4 did three guided breathing exercises. This design was created to specifically compare the effectiveness of each approach.

Before beginning the training, participants were given a questionnaire assessing their baseline experiences with mindfulness. Participants reported their prior experience with mindfulness practice, as well as their comfort level with mindfulness, motivation to practice mindfulness, and beliefs about mindfulness (e.g., mindfulness practice is: “calming,” “new age-y,” “important,” “useless,” etc.). After completing the training, they were asked the same questions, as well as a few additional questions concerning the length of the lesson and their thoughts on how helpful, repetitive, useful, fun, nice, and frustrating the program was.

The groups tended to be comparable across questions. However, group 3 (who did three different mindfulness exercises) showed the highest average increases in beliefs that mindfulness was useful and important. This group also rated the training to be the most enjoyable out of the groups, and this difference was most pronounced when comparing group 3 to group 1 (who only did one exercise). Group 4 (who simply completed three guided breathing exercises) tended to perceive the program favorably, but this group also rated the program as being significantly more “repetitive” than the other groups,  $F(3,36) = 3.52, p = .025$ . We therefore concluded that the overall program design should maximize the opportunities for *diverse* practice exercises.

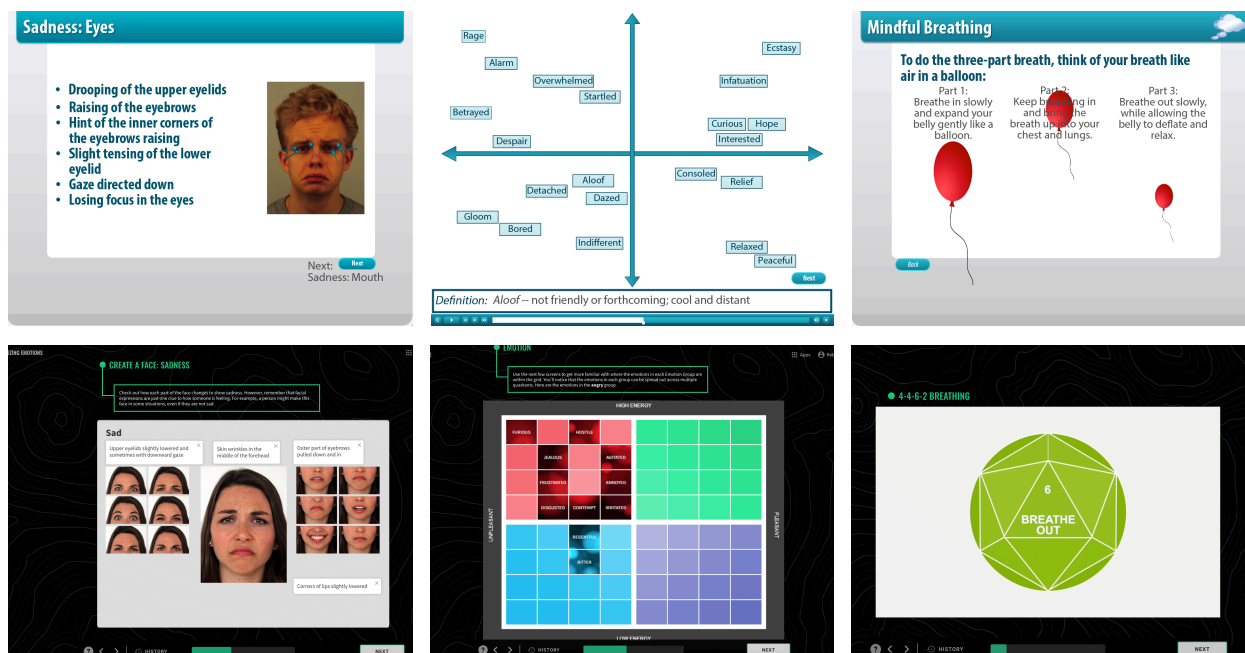
**Cycle 2 Methods & Results.** The program was administered to a second sample of participants ( $n = 131$  participants provided useful data). Of these participants, 125 were general population and 11 were military personnel. In addition, 104 completed the retooled EIT program and 32 provided feedback for a matched placebo program. At the end of each training module, participants completed a short survey about their perceptions of the lesson. This survey included a mix of Likert scales and open-ended questions aimed at assessing the program’s positive features and the areas needing improvement. This included experiences with technical glitches, bugs, and errors, helpfulness of the program, engagement with the training, comprehension of the material, and the general appearance of the program. Data were analyzed after these administrations and feedback was used to fix errors and refine and improve the user experience of the program.

**Qualitative Data:** The bulk of the data collected was qualitative in nature to help guide the final refinement stages of the program. We addressed any critical problems that participants pointed out, especially ones that prevented them from completing the program as intended. We also conducted a thematic analysis on participants’ free responses concerning the first four introductory modules of the program (Tier 1). We chose to focus on the Tier 1 responses because the free responses tended to become less precise as the participants repeatedly answered the same prompts

(e.g., a participant who initially said “the graphics looks very modern and high tech. very attractive” later described the graphics as “good”). This thematic analysis allowed us to explore whether there were consistent patterns in the assessments of the program.

*Technical glitches, bugs and errors:* Participants identified a number of issues, including typos, small font sizes, buttons that did not work as intended, issues with audio and video, flawed feedback, and confusing instructions. With their feedback, we were able address major and consistently reported issues, resulting in a much-improved product.

*Graphic Design.* Participants tended to respond favorably to the graphic design of the new EIT program. When asked “what aspects of the graphics/visual design did you like the most in the lesson?”, 32% of comments mentioned the visual design of the program (e.g., pictures, videos, diagrams, charts). Another 27% of comments mentioned the interactive features of the program, such as pop-up windows, drag-and-drop activities, questions, examples, etc. The program’s color scheme was also well received. Participants thought the background “easy on the eyes”, and the contrast with the text made it highly readable. Participants also called the black background “high-tech”, “modern”, and “sophisticated”. They also liked the use of colors throughout the program, both in terms of engagement and in terms of helping them remember the content. One participant said, “I liked how each step of the emotions chain was a different color which was helpful for remembering each part of the cycle as an individually important thing that comes together”. Finally, participants also mentioned how simple and well-organized the program was. Refer to **Figure 15** below for a comparison of the pilot EIT program and the new EIT program.



**Figure 15.** Examples of differences between the pilot version of the EIT program (top) and the redesigned EIT program (bottom). The retooled program used a black background with vivid contrasting colors, improved pictures, and interactive elements instead of text blocks were possible. The redesigned program also used a logical color scheme (e.g., high arousal, negative valenced emotions in red) that participants seemed to find helpful for understanding the material.



*Perceptions of Engagement.* When asked whether they found the EIT program to be engaging, 85% of the qualitative comments analyzed were positive. In their commentaries, most participants mentioned either the examples and opportunities for real life application (31%), or the interactive activities that required active participation from the user (31%). About 13% of comments mentioned that the program was engaging because the content was interesting and made them excited to learn more. Others (19%) mentioned audio/visual aspects of the program (e.g., color scheme, graphs, videos) and how the information was presented (e.g., clear, well-paced, organized, etc.).

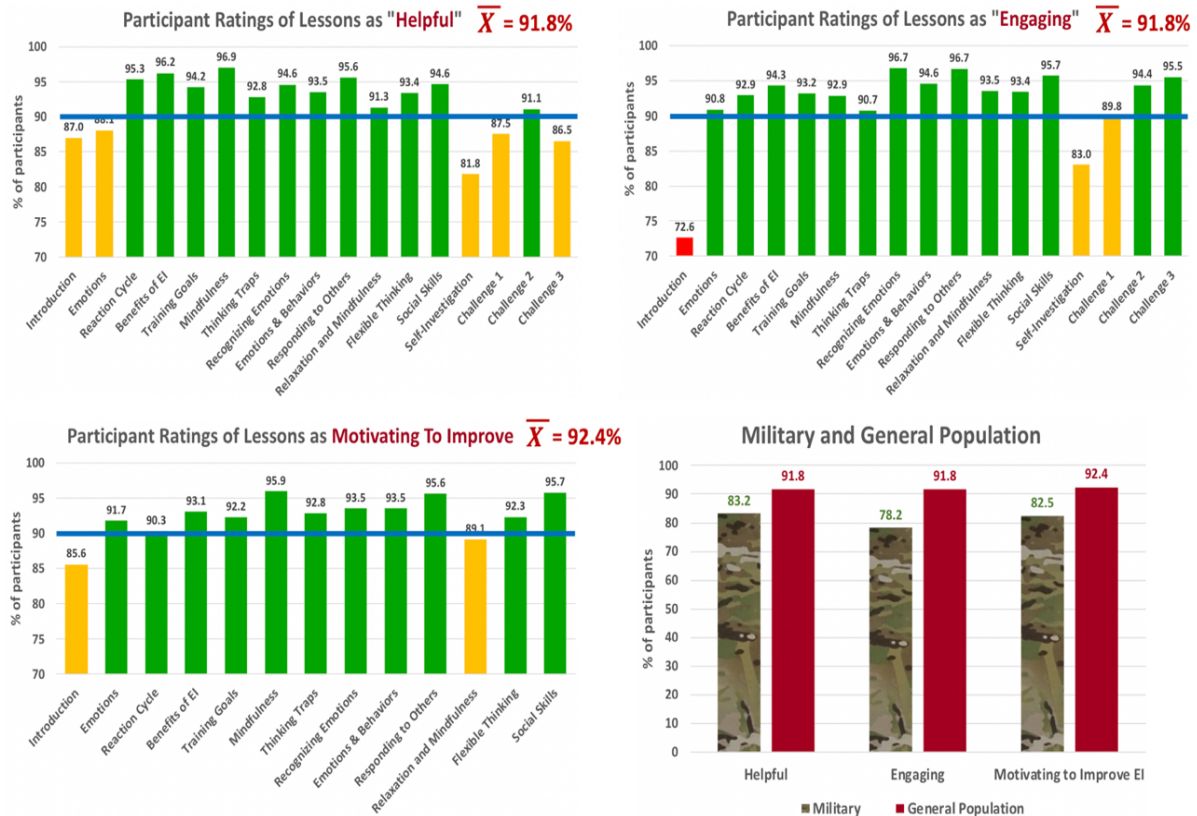
*Perceptions of Helpfulness:* Users overwhelmingly found the EIT program to be helpful, with 88% of the qualitative comments analyzed being positive. Approximately 40% of the comments mentioned how helpful the presentation of information was. Participants commented on how straightforward and well presented the program was, and on how well the program explained things in a way that made sense. Approximately 24% of comments addressed the helpfulness of the program content in providing definitions and theories, introducing ideas they had never considered, and explaining connections between emotions and behavior. 24% of comments also highlighted how the program personally benefited them by making them more conscious of their emotions, helping them understand how the concepts could apply to their lives, and providing them with practical skills they could use in the future.

*Negative/Constructive Feedback:* A minority of participants left comments that were negative in tone (about 12-15%). Most of these comments tended to mention that the EIT program was long and repetitive, and that the information was “common sense” and “nothing new”. Other comments appeared related to personal preference. For instance, many participants found the dark color scheme very appealing, but a few thought it was “depressing” and “scary”. We attempted to address constructive feedback where possible. We also documented the comments that we could not address at the time so that we could potentially address them in future iterations of the program (e.g., offering a “light” and “dark” mode, tailoring examples to military branch, etc.).

Quantitative Data: As part of Task 2, we also obtained subjective user preference ratings on a series of seven-point Likert scales. **Figure 16** shows average “positive” user ratings (i.e., ratings of six or seven) for each of the modules in the program. Overall, user preference ratings suggest that the EIT program was very positively received, with 91.8% of responses stating that it was (6) “helpful” or (7) “very helpful”, 91.8% stating that it was (6) “engaging” or (7) “very engaging”, and 92.4% saying that it was (6) “motivating” or (7) “very motivating”. User preference ratings among the military personnel (Active, Reserve, and ROTC) were comparably high and did not differ significantly from those of the general population (see **Figure 16**).

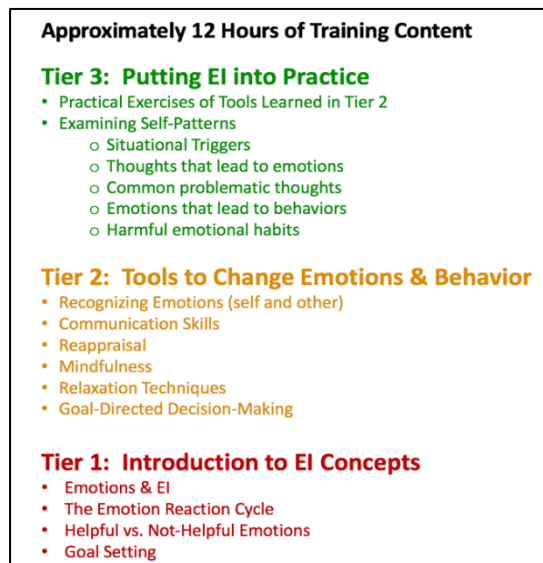
Overall, the qualitative and quantitative findings suggest that the newly redesigned version of the EIT program was positively received by the vast majority of civilian and military personnel, but also provided important areas for further improvement in subsequent iterations.





**Figure 16.** Subjective impression ratings of each module of the EIT program that were provided by 131 participants. Participants were asked to rate each module with regard to how “helpful”, “engaging”, and “motivating to improve” that it was on a 7-point scale ranging from “extremely unhelpful” to “extremely helpful”. The figures show the percentage of participants rating each characteristic positively (e.g., “helpful” to “extremely helpful”). Overall, approval ratings were around 92% across all of the modules. Ratings from 11 military personnel were not different from the general population.

**Final EIT Program:** Through the refinement process, we were able to create a sophisticated, web-based program to enhance emotional intelligence that was well-received by users. The training content is presented through individual modules and organized into three progressive tiers (see **Figure 17**). Overall, the EIT program is self-paced, which allows participants to work through as many or as few modules as desired at any given time. Although the program is self-paced, there are necessary constraints built into the program to help ensure participants are introduced to EI content in a manner that promotes learning. For example, participants must complete all modules in the first, introductory tier, before advancing to Tier 2 and Tier 3. Another constraint of the program is the completion of modules. A single module must be completed prior to opening another



**Figure 17.** The EIT program includes three tiers of training that progressively develop emotional skills. Tiers must be completed in sequential order, starting with Tier 1 and ending with Tier 3.

module. Single modules take between 30 to 60 minutes to complete, and completion time will depend largely on the amount of content presented and how quickly that content is mastered by an individual user. In total, the EIT program includes approximately 10 to 12 hours of training content and activities. These activities can be completed at the pace most comfortable to the user.

Detailed descriptions of these modules can be found in **Appendix C and D** and comprehensive screen captures of the entire EIT program can be found in **Appendix E**. A brief overview of the modules and major content areas is provided below.

### Overview of Modules and Content

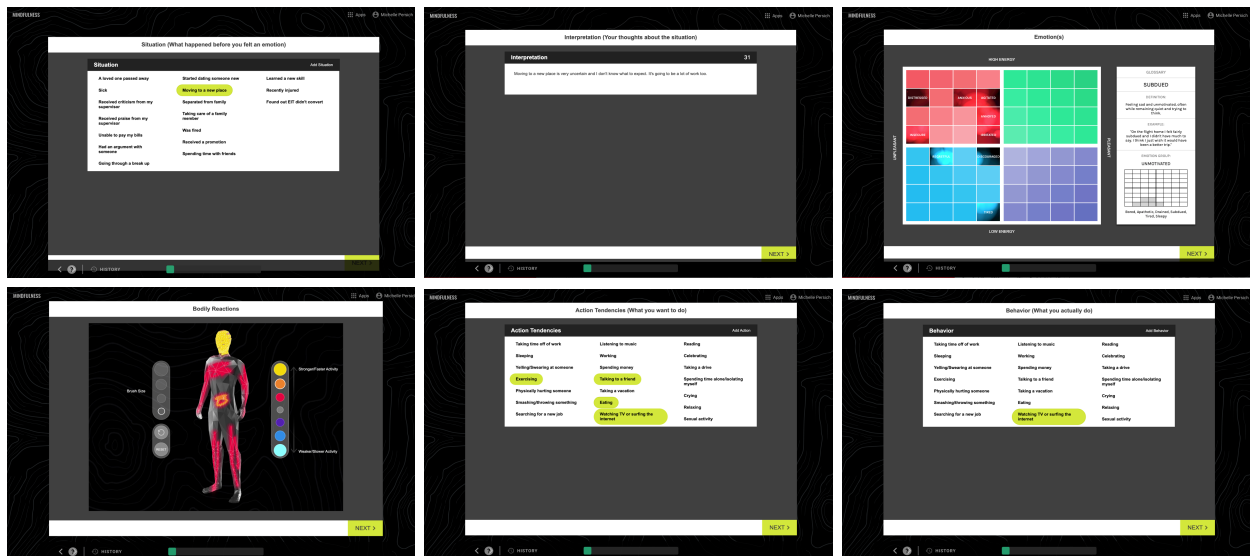
At the beginning of the program, participants are introduced to the EIT dashboard that provides a visual representation of progression through the program (see Appendices). Participants will then be introduced to foundational knowledge in the first tier, followed by more in-depth concepts and practice with those concepts in the second tier. In the final tier, participants will need to synthesize and apply their learned EI concepts to complete multistep challenges. Feedback is provided to participants throughout the EIT program, which provides additional learning opportunities and continued practice with more difficult concepts.

Tier 1. Four modules in Tier 1 comprise the initial lessons and provide a basic foundation for understanding emotions. This basic foundation includes areas such as:

- 1) Establishing the benefits of emotional intelligence (Grewal & Salovey, 2006)
- 2) Dispelling myths about emotions (Putnam & Mumby, 1993; Rimes & Chalder, 2010)
- 3) Providing definitions of specific emotions and a framework for classifying emotions in terms of their valence and arousal (Posner et al., 2005; Smidt & Suvak, 2015)
- 4) Defining and explaining connections between situations, interpretations, emotions, and behaviors (Wright, 2006)
- 5) Helping participants recognize the bodily sensation of emotions (Nummenmaa et al., 2013)
- 6) Teaching participants how emotions can be helpful or harmful (Wright, 2006)

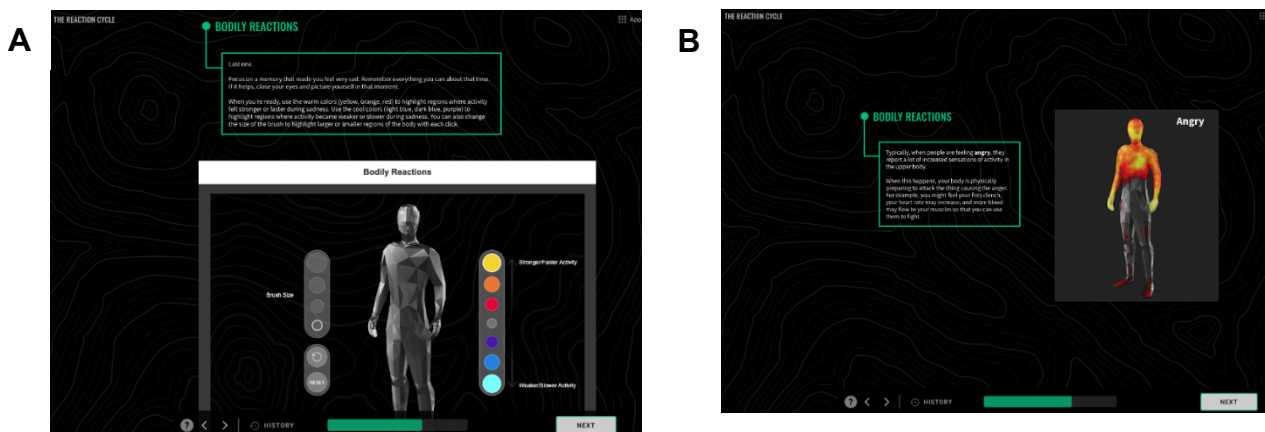
In addition to providing basic knowledge, participants will be given the opportunity to set goals related to EI and identify personal areas for improvement. These goals will be revisited throughout the EIT program and is one example of how the EIT program can be individualized to meet the particular needs of the user. Importantly, participants will be introduced to core elements that will be used throughout the EIT program to teach complex EI content. These core elements include the Emotion Tracker, Bodily Reaction Tool, and Reaction Cycle.

*Emotion Tracker*. The Emotion Tracker is introduced early in Tier 1, but participants have the opportunity to engage with the Emotion Tracker regularly throughout the program to monitor their thoughts, feelings, and behavioral reactions to various situations and stimuli. This self-monitoring feature of the Emotion Tracker provides participants a summary of their current emotional state is completed multiple times throughout the course of the program (see **Figure 18**). This promotes recognition, understanding, and awareness of their own emotions, and the potential causes and consequences of those reactions.



**Figure 18.** Example of an emotion tracker (ET) exercise. In this ET, a person describes an upcoming move, how they interpret the situation, the emotions they are experiencing, their bodily reaction, the behaviors they want to do, and the behaviors they actually did. At the end of the training, participants would receive a summary of their ETs that would highlight possible patterns. This person might learn that they tend to feel anxious when they interpret situations as uncertain and difficult, and that they tend to do avoidance behaviors (e.g., watching tv) when faced with situations that make them anxious.

*Bodily Reaction Tool.* Prior literature that shows how and where in the body emotions are generally felt (see **Figure 11**). Building upon this empirical data, we created the Bodily Reaction Tool in the EIT program (see **Figure 19**). This activity is designed to help participants understand that experiencing an emotion can induce physiological reactions/sensations in different parts of the body. Participants monitor their somatic sensations and identify where, in their body, they feel different sensations when experiencing different emotions. Through continual use of this tool throughout the program, participants will learn to recognize their emotions more accurately and be more in tune with their physiological reactions to emotion. The tool allows participants to click

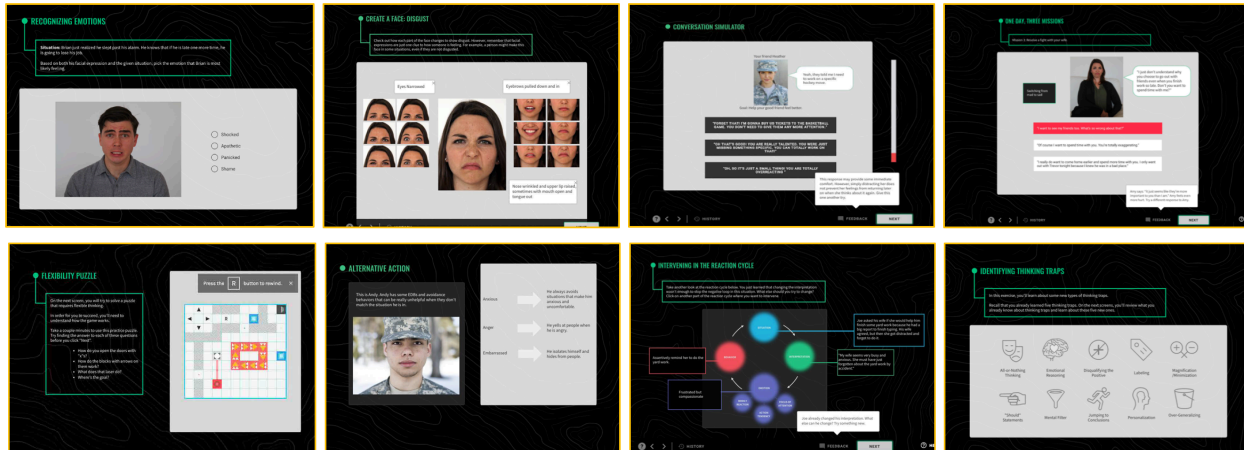


**Figure 19.** Bodily Reaction Tool in the EIT program. **A.** Participants are introduced to the tool and can manipulate the size and color of the brush. Warm colors indicate stronger/faster activity, while cool colors indicate weaker/slower activity. **B.** Participants are given examples of body reactions based on empirical data.



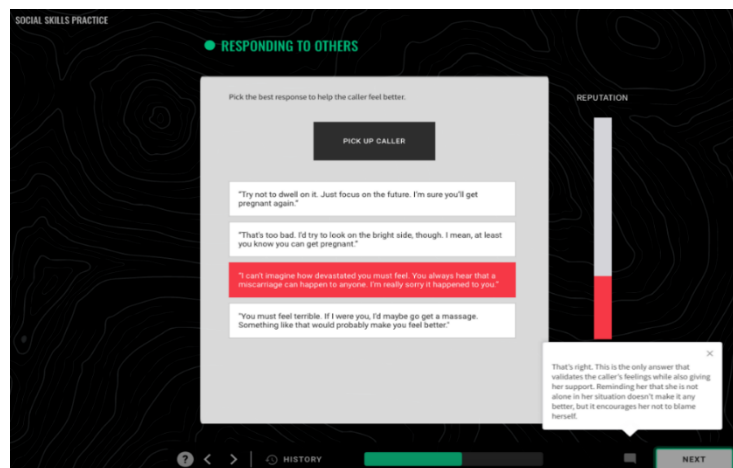


and must drag the correct combination of eyes and mouth onto the face to create a face that matches the emotion. This training lesson helps individuals learn the subtle features of facial expressions that contribute to the communication of various emotions and provides participants with an understanding of the difficulty in recognizing emotions without context.



**Figure 21.** Example screenshots from training tasks focused on emotional perception, communication skills, social connection, cognitive flexibility, decision-making, and cognitive thinking traps.

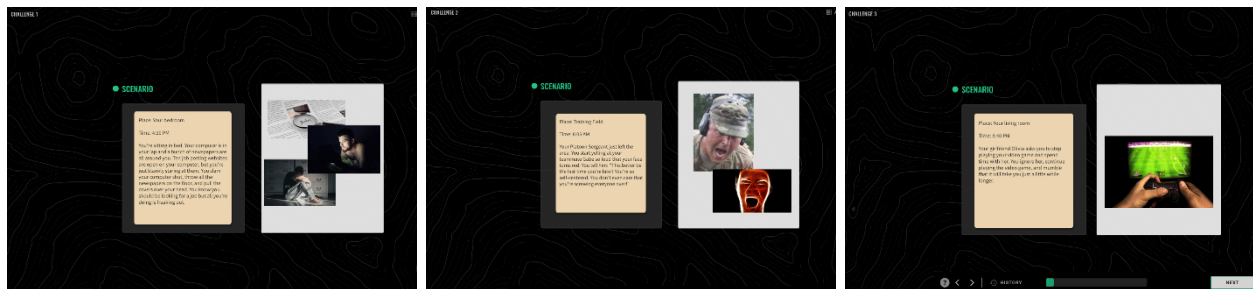
*Responding to Others.* The *Responding to Others* activity in Tier 2 (**Figure 22**) teaches participants to recognize and choose optimal responses to other individuals within emotionally difficult situations. These scenarios are described via audio recordings by trained actors. For this activity, the participant will engage in a form of role play where they assume the role of a telephone hotline operator, helping individuals on the line deal with various stressful situations. After hearing a particular scenario, the participant will be presented with a series of choices for their response and must select the most appropriate response for that scenario. A status bar on the right of the screen reflects the participant's “reputation” as a knowledgeable relationship expert. This status bar will increase when participants select the most appropriate response and decrease when participants select the least appropriate response. Additional feedback in the bottom right of the screen will appear to further explain the appropriateness of the selected response.



**Figure 22.** Responding to Others activity in the EIT program. Participants will listen to a scenario and select the most appropriate response.

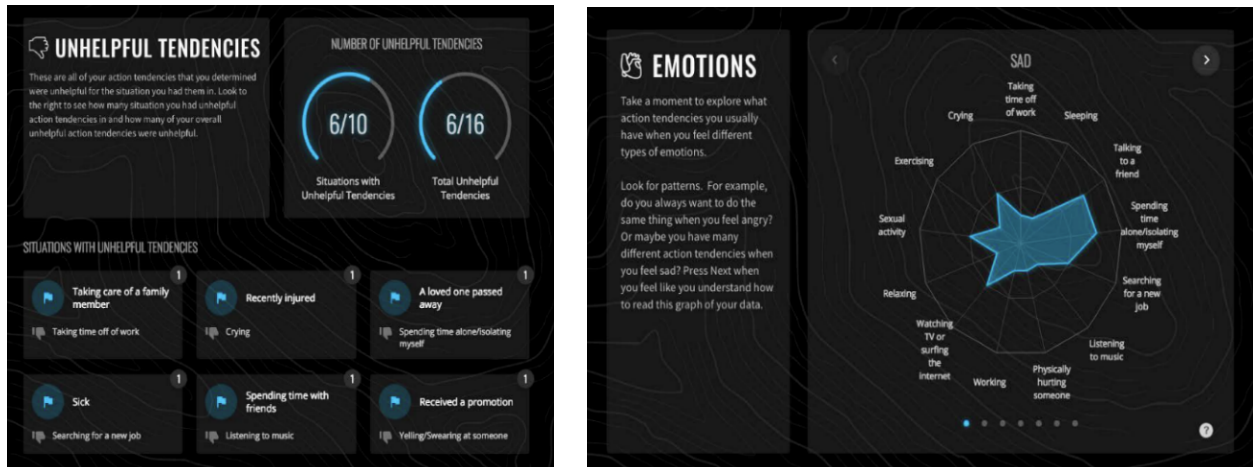
Tier 3. After completion of Tier 2, participants will advance to the final tier of the EIT program. In this tier, participants will be reminded of the information they learned in the previous modules and given the opportunity to integrate and apply this knowledge to new situations and challenges.

For example, participants are given opportunities to use their newly acquired skills to manage various emotional scenarios (see **Figure 23**).



**Figure 23.** Opportunities for participants to apply previously learned emotional skills to resolve a difficult situation. Participants were given the chance to use their skills to manage distress over trying to find a new job (left), help a teammate who is struggling to show up to training on time (middle), and resolve a fight with a significant other (right).

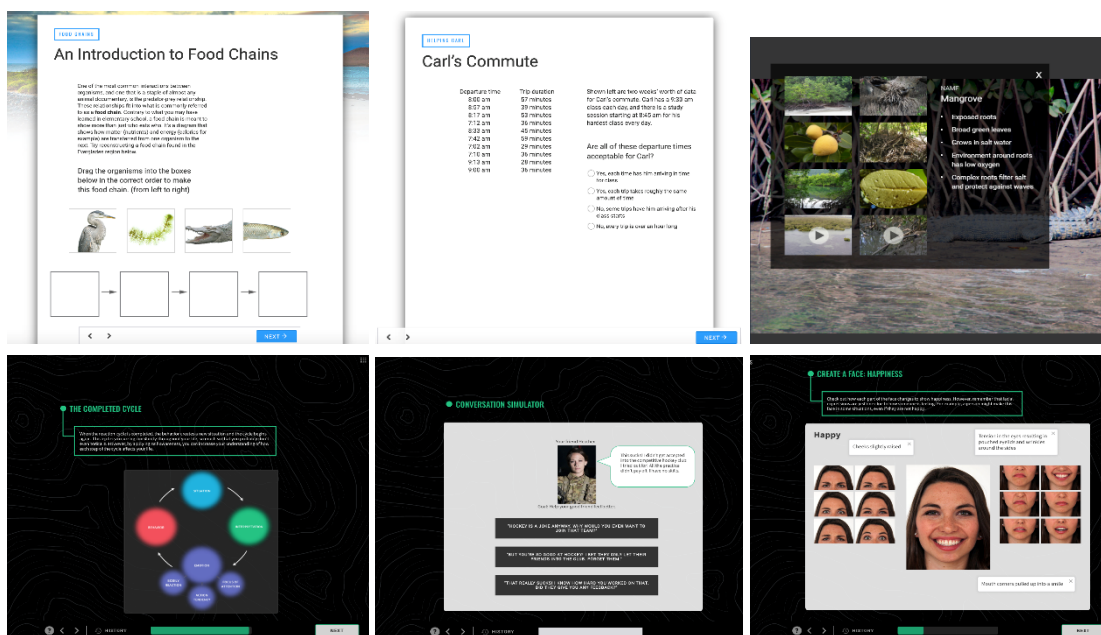
This tier also provides the opportunity for greater self-exploration. Personal goals that were set during the introductory tier of the EIT program will be revisited. The program will also compile and summarize the results of the emotion tracker activities (see **Figure 24 left**) and allow the participant to explore potential patterns and areas of difficulty (see **Figure 24 right**). Finally, the program provides the participants with the chance to self-reflect on their experience with the program and prompts them to think about how they can use the skills learned in the program to benefit their personal lives.



**Figure 24.** Example screenshots from Tier 3 of the EIT program wherein participants utilize knowledge and skills from Tier 1 and Tier 2 to focus on self-exploration and summarization of their overall progression in the program.

**Placebo Awareness Training (PAT) Program:** For the research projects to be completed in Tasks, 3-6, it was important to also have a non-emotion-based training condition to use as a comparison. Therefore, a matched Placebo Awareness Training (PAT) program was developed as the control condition. This control program is similar to the EIT program in visual complexity, difficulty level, and time commitment but had no training in emotional topics. Participants who are randomly assigned to this condition will also be given the same amount of time to complete the 10 to 12-

hour PAT program. Content for the PAT program is presented using a comparable 3-tier structure comprised of singular modules. Example comparisons between the programs can be found in **Figure 25**. Although both programs focus on the concept of “awareness,” the EIT program focuses on “internal awareness,” and the PAT program focuses on “external awareness.” Instead of emotional content or emotion-specific training, the PAT program focuses on the concept of “Energy for Life”. More details about the PAT program and examples of content can be found in **Appendix C**.



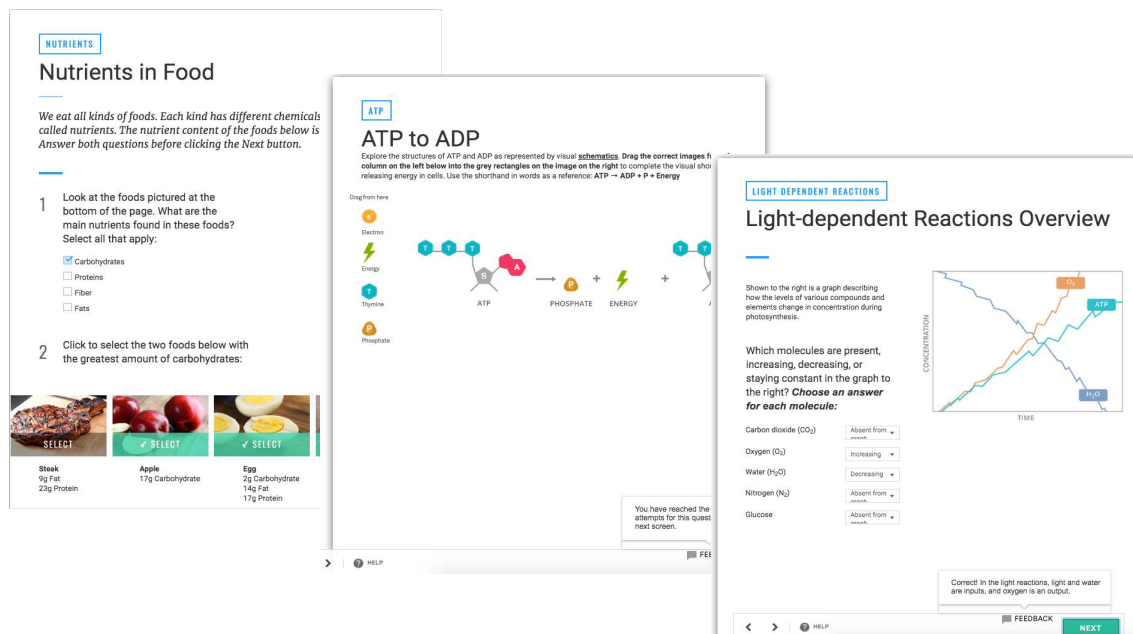
**Figure 25.** Comparisons of content between programs. Top images show PAT lessons concerning food chains, scientific problem solving and how to recognize a tree by its features. Bottom images show EIT lessons concerning reaction cycles, how to solve problems using emotional skills, and how to recognize emotions by facial features.

**Tier 1.** The first tier of the PAT program involves learning to think, see, and hear like a scientist and participants will develop basic skills on how to become aware of the external environment. Similar to the EIT program, participants are introduced to foundation knowledge in this first tier, which will be used throughout the remainder of the program. Modules in this tier focus on how living things get energy from each other and the types of food people need for energy.

**Tier 2.** The second tier provides detailed information on how living things get energy from what they eat. Participants learn how living things store energy for later through the use of interactive graphs and activities presented in separate modules. These interactive activities provide participants opportunities to engage with the program content in ways that are similar to the EIT program. Furthermore, as in the EIT program, feedback is provided to participants in the bottom right section of the screen throughout the program. Content from this tier of the PAT program is shown in **Figure 26**.

**Tier 3.** The final tier involves learning about various locations around the world to apply the learned awareness skills to understanding plants, animals, and environmental attributes of the earth. Participants will explore six different places in the world to search for living things. This





**Figure 26.** Example screenshots of the Placebo Attention Training (PAT) program control condition. Activities presented in Tier 2 are highly interactive and allow participants the opportunity to engage with the training program content.

final tier provides participants an opportunity to incorporate the concepts and skills learned in the previous tiers, including how to group living things based on what they eat and how they get and store energy. Screenshots from two of the modules in Tier 3 are presented in **Figure 27**.



**Figure 27.** Example screenshots of Tier 3 Placebo Attention Training (PAT) control condition. Tier 3 focuses on learning world locations to apply learned awareness skills from previous tiers.

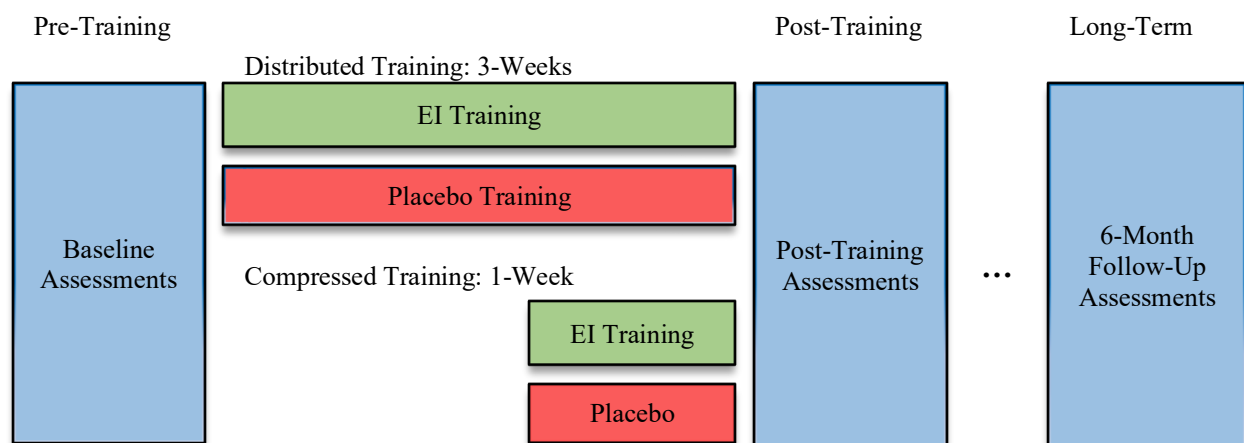
**Conclusion:** Through a thorough refinement process, we were able to create a comprehensive web-based program for building emotional intelligence skills. This program was well received by participants and looked visually appealing. At the same time, we were also able to create a matched placebo program to use as a control condition. The work done in that task produced a final product that then was ready for the next step in the project: Task 3 efficacy testing.



### 3.3 TASK 3: Efficacy Study

**Overview:** Our efforts in completing the Task 2 iterative refinement process yielded a sophisticated and fully developed emotional intelligence training program (EIT) and a matched placebo awareness training program (PAT). The next step in the project then was to conduct a large-scale study aimed at demonstrating whether the EIT program was, in fact, capable of improving targeted emotional abilities. In conjunction with the findings reported for Task 2, Task 3 was designed to provide the final piece addressing *Specific Aim #1: Identify key training components (i.e., content, frequency, duration, number of lessons) that lead to the greatest improvement in measured EI skills across all four domains.*

This large-scale efficacy study had two main goals: 1) to demonstrate the efficacy of the program, and 2) to determine the most effective duration of the training (i.e., 1-week or 3-week completion period). Participants completed an initial set of baseline assessments that measured core emotional abilities. They were then randomly assigned to take either the EIT training or the PAT training, and they were also randomly assigned to a one-week (compressed) or three-week (distributed) completion schedule. Upon completion of the training, participants returned to complete a post-training session in which they completed the same set of questionnaires as in their baseline session. Finally, a subset of participants completed a six-month follow-up assessment session to determine the longevity of improvements (see **Figure 28**). All assessments were done in person in the lab.



**Figure 28.** Diagram of the Task 3 study design. Participants completed their baseline assessments and were randomly assigned to one of four training program conditions. After completing the training, participants did a post-training assessment session. After a six-month waiting period, a subset of the participants completed a long-term follow-up assessment session.

Data collection for the first 448 participants ran according to plan. However, in March 2020, the World Health Organization declared the COVID-19 outbreak a pandemic. The University of Arizona halted all in-person research, and we had to pivot to remote testing to protect the health and safety of our participants. The basic study design remained relatively the same. The major changes were that 1) participants completed the assessment sessions completely online instead of in-person at our laboratory, and 2) all post-COVID participants were allowed to complete the training within three weeks and could do so flexibly rather than following our strict schedule.

Because of the protocol changes and changes to the general state of the world, we will present results from these two samples separately. We will refer to the pre-COVID sample as “*in-person*” and the post-COVID sample as “*remote*”.

**Sample Description:** Participants were recruited from the University of Arizona and the surrounding Tucson metropolitan area. Participants were recruited through flyers, listserv emails, and advertisements in newspapers, Facebook, and Instagram. For the in-person sample, a total of  $n = 448$  participants completed the baseline session,  $n = 326$  completed the post-training session, and  $n = 92$  completed the six-month follow-up. For the remote sample, a total of  $n = 125$  participants completed the baseline session,  $n = 109$  participants completed the post-training session, and  $n = 83$  participants completed the six-month follow-up. **Table 3** presents the characteristics of the in-person and remote assessment samples.

**Table 3**

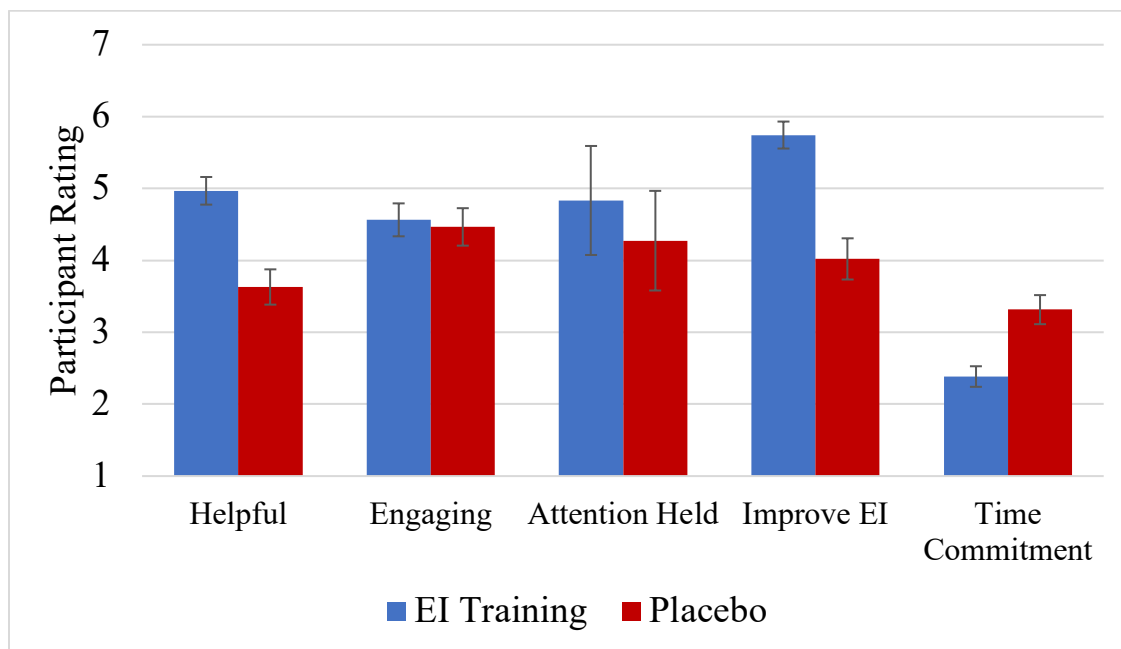
*Characteristics of Participants at Baseline, Post-Training, and Six-Month Follow-Up*

	In-Person			Remote		
	Baseline $n = 448$	Post-Tx $n = 326$	6-Month $n = 92$	Baseline $n = 125$	Post-Tx $n = 109$	6-Month $n = 83$
Age	23.70 (5.58)	23.51 (5.39)	23.63 (5.48)	24.06 (5.98)	24.08 (5.94)	24.14 (6.00)
Gender						
Male	28%	28%	29%	31%	31%	24%
Female	72%	72%	71%	69%	69%	76%
Ethnicity						
White	61%	62%	65%	59%	62%	61%
Black or African American	3%	3%	3%	4%	3%	2%
Native American or Alaska Native	1%	1%	1%	1%	1%	1%
Asian	6%	6%	8%	6%	6%	7%
Native Hawaiian or Pacific Islander	.1%	0%	0%	0%	0%	0%
Latino or Hispanic	21%	21%	21%	21%	19%	18%
More than one race	6%	5%	2%	8%	7%	8%
Other	1%	1%	0%	8%	9%	1%
Prefer not to answer	1%	1%	0%	8%	9%	1%
Randomization						
1-Week EIT	25%	29%	27%	NA	NA	NA
3-Week EIT	27%	23%	33%	50%	53%	52%
1-Week PAT	23%	25%	24%	NA	NA	NA
3-Week PAT	24%	23%	16%	50%	47%	48%

### **In-Person Study (Initially Proposed Sample)**

**Analyses:** To examine the effectiveness of the program, we conducted a series of program (EIT, PAT) x time (baseline, post-training, six-month follow-up) ANCOVAs. We included age and sex as covariates, as these variables have been shown to correlate with emotional abilities (Fernandez-Berrocal et al., 2012). Ability EI has also been criticized for overlapping with general intelligence (Fiori & Antonakis, 2011). We therefore also controlled for general intelligence, as measured by the Wechsler Abbreviated Scale of Intelligence (Wechsler, 2011), which was administered to all participants at baseline.

**Program Perceptions:** As in the earlier phases of the project, we continued to assess subjective perceptions of the program. In the present study, we asked participants to rate how helpful, engaging, motivating, attention holding, and time consuming the program was (1 = not at all; 7 = very). This was similar to what was asked in the Task 2 study, however, in this study, we asked participants to rate the program as a whole, rather than each separate module. As shown in **Figure 29**, participants had positive perceptions of the EIT program. Participants tended to view both the EIT and the placebo programs as similarly engaging,  $t(300) = .59, p = .553$ . However, participants in the EIT program perceived the training to be more helpful,  $t(300) = 8.33, p < .001$ , and were more motivated to improve their emotional intelligence,  $t(300) = 9.69, p < .001$ , relative to participants in the placebo program.



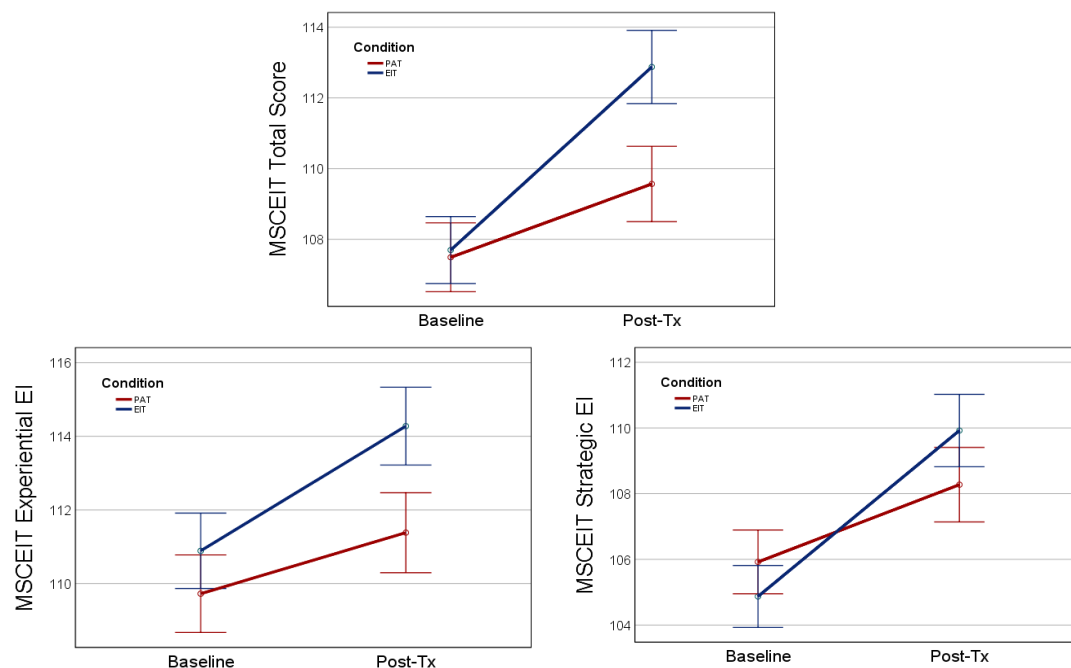
**Figure 29.** Comparison of Program Perceptions for the EI training program and the Placebo Awareness Training

**Hypothesis 1.** *The EI Training Program will produce significantly greater enhancement of EI scores than a matched Placebo Training Program, regardless of training duration.*

**Ability Based Emotional Intelligence:** The main outcome of the study was improvement in EI abilities. Ability EI was measured using the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT: (Mayer et al., 2002)). The MSCEIT is considered to be the “gold-standard” for

measuring EI abilities and the training program was largely built around this MSCEIT model of EI. The MSCEIT assesses the ability to perceive, use, understand, and manage emotions. The scale also includes a total score that reflects overall EI abilities (Total EI). Results showed that the EIT program was effective at improving the MSCEIT total score,  $F(1, 316) = 6.82, p = .009, \eta_p^2 = .02$ . As shown in **Figure 30 (top)**, participants assigned to the EIT program showed a greater improvement to their EI total scores relative to those in the PAT program. Participants in the EIT program increased their EI scores nearly 5 points, moving from what the MSCEIT manual describes as a “high average” range (100-109) to the “competent” range (110-119). *This finding suggests that the EIT program did successfully improve Ability EI.*

We further investigated the effects of the EI training program by examining changes in the two MSCEIT Area Scores and each of the four MSCEIT branch scores. The Experiential Area is comprised of two branches, Perceiving and Using emotions. For Experiential EI, the program x time interaction was not significant, although the interaction was in the hypothesized direction,  $F(1, 316) = 1.76, p = .185, \eta_p^2 = .01$  (see **Figure 30, bottom left**). The Strategic EI area score is comprised of the understanding and managing emotions branches. For strategic EI, the program x time interaction was significant,  $F(1, 316) = 4.58, p = .033, \eta_p^2 = .01$  (see **Figure 30 bottom right**). In terms of particular EI abilities, the first three MSCEIT branches of perceiving, using, and understanding emotion were not significant,  $ps = .989, .186, \text{ and } .143$  respectively. There was a marginal trend toward significance for the managing emotion branch,  $F(1, 316) = 3.64, p = .057, \eta_p^2 = .01$ .

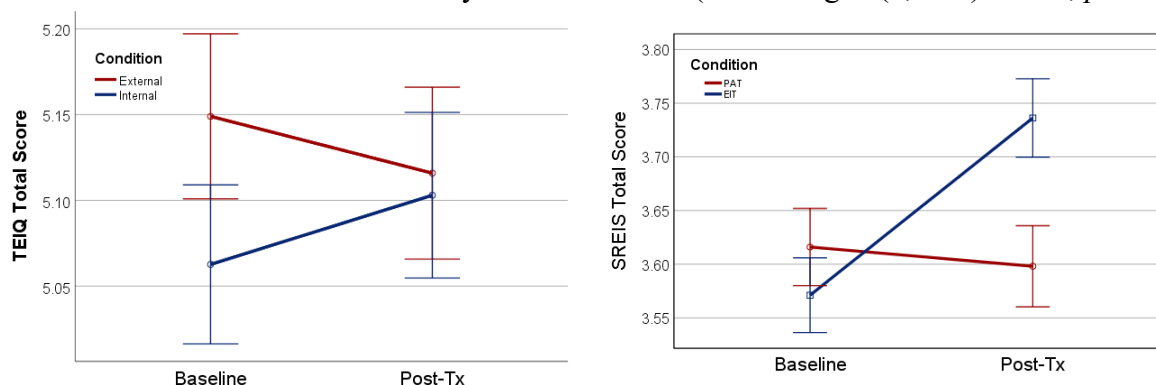


**Figure 30.** Improvement to performance-based EI abilities as a function of program condition and time.

Self-Reported Emotional Intelligence: We also collected self-reports of both trait EI and self-perceived EI abilities. Trait EI was measured using the trait emotional intelligence questionnaire

(TEIQue) This 153-item scale comprehensively assess domains related to trait EI, measuring factors of well-being, self-control, emotionality, and sociability as well as an overall score (Petrides, 2009). Self-reported EI ability was assessed using the self-reported emotional intelligence scale (SREIS), which is a 19-item scale designed to map onto the skills assessed by the MSCEIT (Brackett et al., 2006).

We found support for our hypothesis that EI training would increase self-reported EI relative to placebo training. As shown in **Figure 31**, individuals in the EIT program showed an increase in total TEIQue scores relative to those in the PAT program,  $F(1, 319) = 3.89, p = .050, \eta_p^2 = .01$ . An examination of subscales revealed that the program tended to affect the subscales that targeted social-emotional abilities. Individuals in the EIT group significantly improved scores on the emotionality subscale,  $F(1, 319) = 5.52, p = .019, \eta_p^2 = .02$ , and marginally improved on the sociability subscale,  $F(1, 319) = 3.33, p = .069, \eta_p^2 = .01$ . There were no significant effects found for the subscales that were more closely related to traits (well-being:  $F(1, 319) = .43, p = .514$ ,

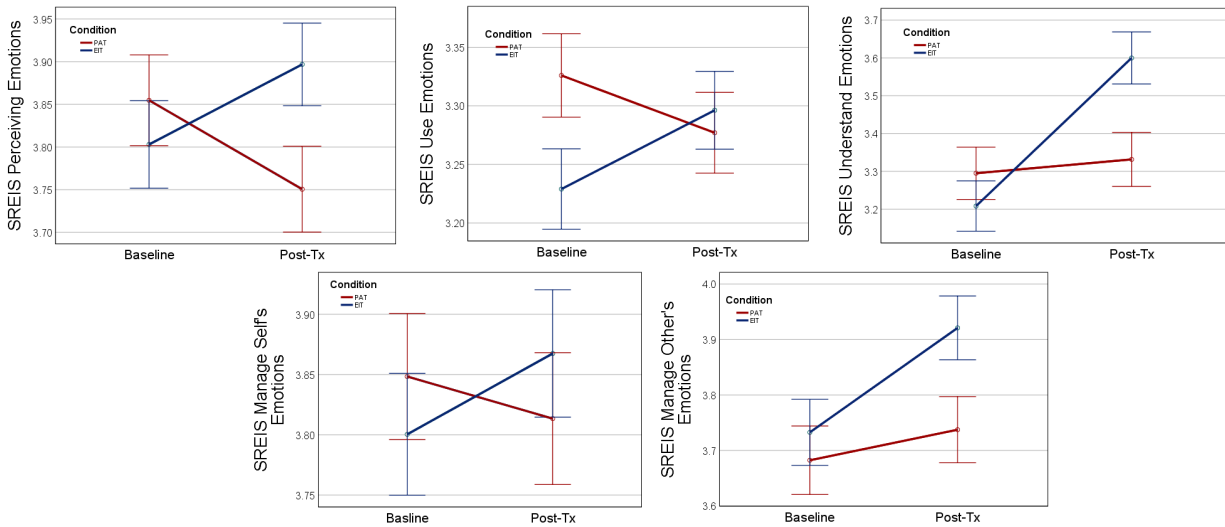


**Figure 31.** Improvement to self-reported EI as a function of program condition and time.

$\eta_p^2 = .00$ ) or broader behavioral tendencies (self-control:  $F(1, 319) = .25, p = .616, \eta_p^2 = .00$ .

We also found that the individuals in the EIT program showed stronger improvements to total SREIS scores relative to individuals in the PAT program,  $F(1, 319) = 21.41, p < .001, \eta_p^2 = .06$  (see **Figure 31**). We also examined the subscales of the SREIS to understand which components were being improved by the EI training. As shown in **Figure 32**, participants in the EIT program demonstrated significant increases in nearly all dimensions of emotional intelligence on the SREIS. Participants showed significant increases in self-reports of ability to perceive emotion,  $F(1, 319) = 11.62, p < .001, \eta_p^2 = .04$ , use emotion,  $F(1, 319) = 4.16, p = .042, \eta_p^2 = .01$ , understand emotion,  $F(1, 319) = 22.50, p < .001, \eta_p^2 = .07$ , and manage the emotions of others,  $F(1, 319) = 4.36, p = .038, \eta_p^2 = .01$ . The effects for perceiving and understanding emotions were particularly strong ( $\eta_p^2 = .06$  indicates a medium effect), suggesting that the program helped people feel more aware of, attuned to, and knowledgeable about their emotions. Overall, these findings show meaningful improvement in self-reported EI abilities following completion of the EIT training compared to the placebo. This provides preliminary support for the efficacy of using the EIT program for enhancing self-perceived EI.

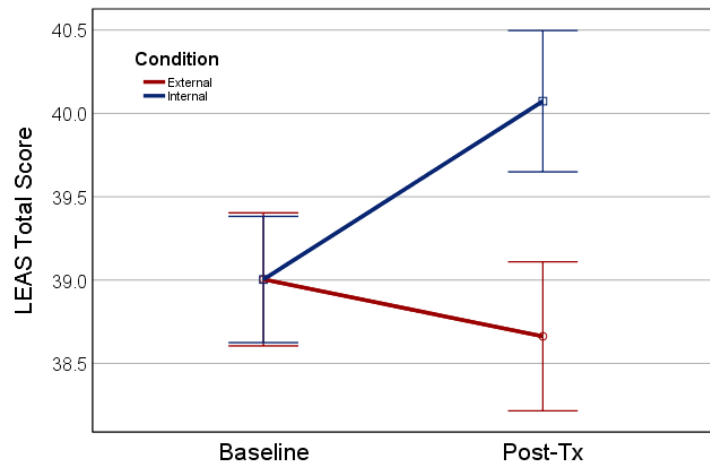
**Emotional Abilities:** Our central hypothesis focused on improvements to core EI metrics. However, to provide further cross-validation of program efficacy, we assessed a number of other



**Figure 32.** Improvement to self-reported EI abilities as a function of program condition and time.

emotional abilities that are related to EI, but not explicitly based on the Mayer-Salovey-Caruso model of EI. Such abilities include emotional awareness, interoceptive awareness, emotion regulation, and emotional perception.

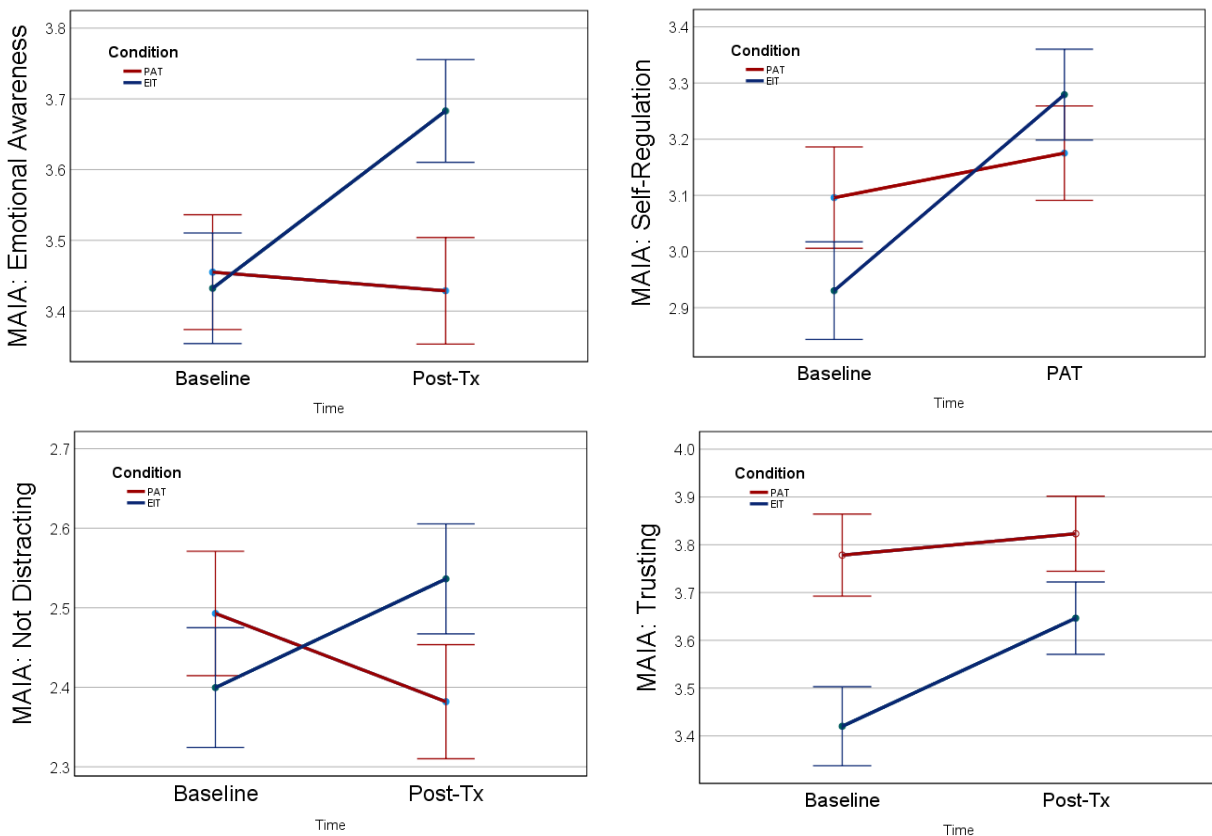
*Emotional Awareness:* Emotional awareness (EA) describes the ability to experience emotion at varied levels of complexity and differentiation. The construct of EA is thought to be a critical component of many the emotional skills we sought to improve in the training (Smith et al., 2018). We assessed EA using the Level of Emotional Awareness Scale (LEAS: (Lane et al., 1990)). As shown in **Figure 33**, participants randomly assigned to the EIT program showed a significant improvement in the LEAS scores relative to the Placebo group,  $F(1, 259) = 7.05, p = .008, \eta_p^2 = .03$ . This suggests that the EIT program was effective at developing a richer, more complex, and differentiated level of understanding and experiencing emotion.



**Figure 33.** Changes in levels of emotional awareness as a function of program condition and time.

*Interoceptive Awareness:* Interoceptive awareness refers to the ability to identify, understand, and respond to internal signals. This interoceptive awareness should enhance emotional abilities as it allows individuals to better perceive emotions, understand their emotional reactions, and appropriately regulate emotions. Interoceptive awareness was measured using the Multidimensional Assessment of Interoceptive Awareness (MAIA: (Mehling et al., 2012)). The MAIA assesses eight dimensions of interoceptive awareness, including: 1) noticing sensation, 2) not distracting from sensations, 3) not worrying about sensations, 4) attention regulation, 5)

emotional awareness, 6) self-regulation, 7) body listening, and 8) trusting bodily sensations. Our results showed that the EIT program was successful at improve many of the dimensions of interoceptive awareness. As shown in **Figure 34**, individuals in the EIT program showed improvements to their emotional awareness,  $F(1, 319) = 7.92, p = .005, \eta_p^2 = .02$ , and self-regulation,  $F(1, 319) = 6.39, p = .012, \eta_p^2 = .02$ , compared to those in the placebo program. They also showed improvements in their ability to not distract themselves from unpleasant sensations,  $F(1, 319) = 4.78, p = .030, \eta_p^2 = .01$ , and felt more comfortable trusting their bodily sensations,  $F(1, 319) = 3.97, p = .047, \eta_p^2 = .01$ . We did not find significant improvements to interoceptive awareness dimensions of noticing sensations,  $F(1, 319) = 1.13, p = .290, \eta_p^2 = .00$ , attention regulation,  $F(1, 319) = 2.42, p = .121, \eta_p^2 = .01$ , body listening,  $F(1, 319) = 2.11, p = .147, \eta_p^2 = .01$ , and not worrying,  $F(1, 319) = .01, p = .921, \eta_p^2 = .00$ . These findings suggest that the EIT program helped individuals become more in touch with their internal signals and improved their ability to understand and regulate their physiological manifestations of emotion.

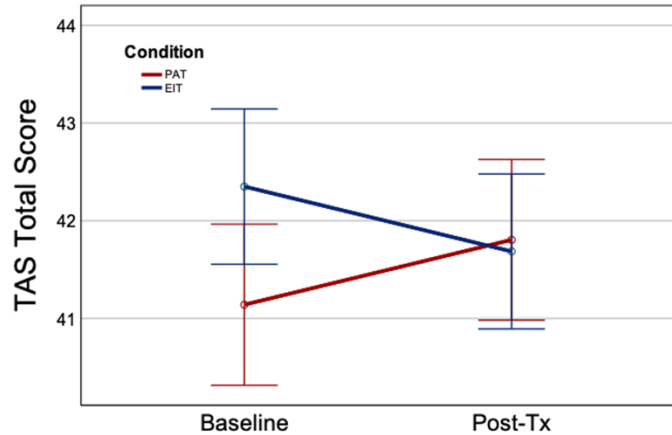


**Figure 34.** Changes in interoceptive awareness as a function of program condition and time.

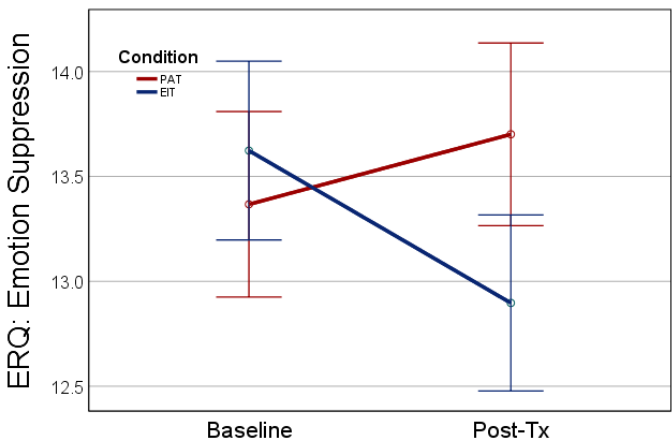
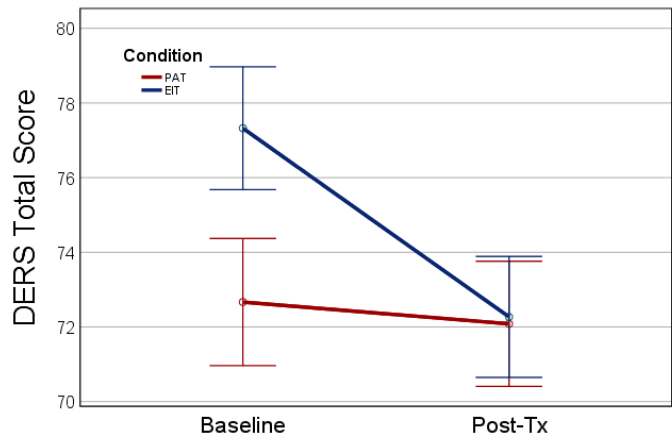
*Feeling Emotion.* Alexithymia is characterized by a difficulty in the cognitive processing of emotions. Alexithymia was assessed using the Toronto Alexithymia Scale (TAS: (Bagby et al., 1994)), which provides an overall score as well as three sub-components: difficulty identifying feelings, difficulty describing feelings, and a tendency for externally oriented thinking. Participants in the EIT program showed a marginal improvement in their total TAS scores,  $F(1, 319) = 2.95, p = .087, \eta_p^2 = .01$  (**Figure 35**). Upon examination of the subscales, we found that the effect was driven by improvements on the externally oriented thinking subscale. This subscale

is often implicated in deficits in critical emotional abilities target it the EIT program, including empathy and facial recognition of emotions (Demers & Koven, 2015; Lyvers et al., 2017).

*Emotion Regulation.* Emotion regulation is an important skill for adaptively navigating stressful and emotionally demanding circumstances. We assessed difficulty regulating emotions using the Difficulties in Emotion Regulation Scale (DERS: (Gratz & Roemer, 2004)). We also assessed the tendency to use two specific emotion regulation strategies, cognitive reappraisal and emotion suppression, using the Emotion Regulation Questionnaire (ERQ: (Gross & John, 2003)). As shown in **Figure 36**, participants in the EIT program showed declines in their overall difficulties regulating emotions,  $F(1, 318) = 7.67, p = .006, \eta_p^2 = .02$ . In terms of specific difficulties, participants reported fewer difficulties with non-acceptance of emotions,  $F(1, 318) = 4.98, p = .026, \eta_p^2 = .02$ , lack of emotional awareness,  $F(1, 318) = 5.72, p = .017, \eta_p^2 = .02$ , and lack of clarity,  $F(1, 319) = 10.24, p = .002, \eta_p^2 = .03$  following EI training. There was a marginal time x program interaction for lack of emotion regulation strategies,  $F(1, 318) = 3.22, p = .074, \eta_p^2 = .01$ . There were no significant interactions for difficulties related to goals,  $F(1, 318) = 2.10, p = .148, \eta_p^2 = .01$  or impulsivity,  $F(1, 318) = .09, p = .770, \eta_p^2 = .00$ . In terms of specific emotion regulation strategies, there was effect of time and program assignment on the use of cognitive reappraisal,  $F(1, 319) = 1.67, p = .198, \eta_p^2 = .01$ . However, individuals in the EIT program reported being less likely to use the typically ineffective strategy of emotional suppression following training,  $F(1, 319) = 5.19, p = .023, \eta_p^2 = .02$ . Together, these findings suggest that EI training helped combat emotion regulation difficulties and reduced the use of ineffective strategies.



**Figure 35.** Changes in the TAS over treatment.



**Figure 36.** Changes in the use of emotion suppression as an emotion regulation strategy as a function of program condition and time.



Interpersonal Abilities: Social-emotional skills allow individuals to form and maintain healthy, positive interpersonal relationships. These relationships play vital roles in both job performance and psychological well-being (Morgeson et al., 2005; Segrin & Taylor, 2007)

*Interpersonal Affect Regulation:* Managing the emotions of others is a key element of EI. We recently developed an ability-based assessment to measure individual's abilities to select responses that are effective for managing the emotions of others. We call this test the Interpersonal Affect Regulation Task (IPART). The test presents a series of hypothetical scenarios in which the participants imagine themselves in a conversation with another person who is experiencing an emotionally upsetting situation. Participants are tasked with choosing from four different ways of responding to the upset person and indicating 1) which response they believe to be most effective (the best choice) and 2) which response they would personally do if they were in the situation (personal choice). According to the situation judgment test literature, "best choice" responses are an indication of maximal performance and knowledge of what to do in a situation (Ployhart & Ehrhart, 2003). The "personal choice" responses are an indication of typical performance and behavioral tendencies (Ployhart & Ehrhart, 2003). Both response types provide valuable information about a person's abilities, and there are large individual differences in the extent to which individuals choose the same "best choice" and "personal choice" answers (Robinson et al., 2022).

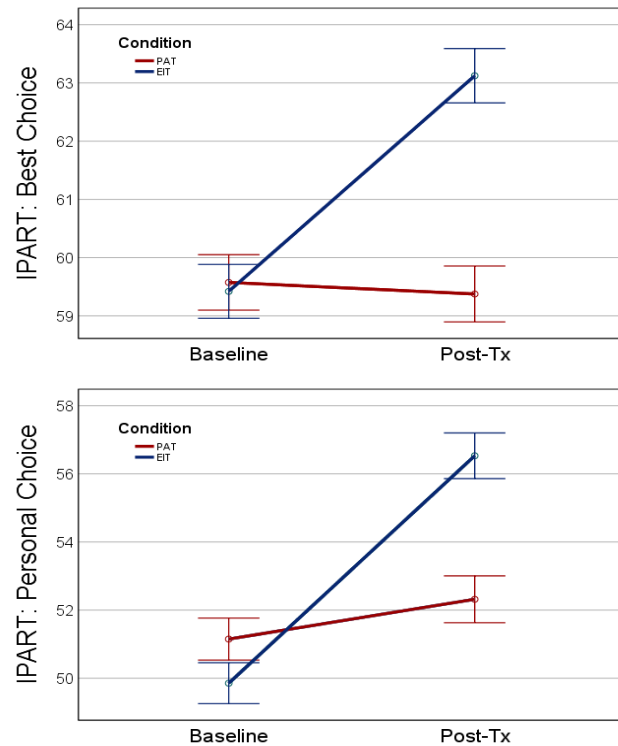
For both the "Best Choice" and "Personal Choice" responses, participants must choose among four responses that address theoretically different levels of interpersonal affect regulation ability. One of the responses is defined as an "Improve" response. This response is theoretically the most emotionally intelligent answer because it addresses and nonjudgmentally validates the emotion of the other person, while also providing constructive feedback or proactive suggestions to help the individual improve their situation. Participants receive 2 points for every "Improve" response that they select. Two of the four available responses are as "Diversion" responses. These responses attempt to distract the hypothetical other person without fully acknowledging the person's emotions or particular situation. Diversion responses are considered broadly prosocial as they represent an attempt to help the other person. However, it is considered to be less emotionally intelligent and effective as an "Improve" response, as the lack of attention to the emotions of the other person may leave that person feeling invalidated and still struggling with the problem. Therefore, participants only receive 1 point for every "Diversion" response they chose. Finally, the fourth potential response is as a "Worsen" response. These responses are invalidating, judgmental and/or insensitive that would likely make the hypothetical person feel worse about the situation. Participants receive 0 points for every "Worsen" response they select.

To determine the effectiveness of the EIT program for enhancing the types of emotional management skills measured by the IPART, we administered the IPART at baseline and again following completion of the program. **Figure 37** shows that participants started around the same average ability. Following completion of the program, participants in the EIT program had showed strong improvements in their interpersonal affect regulation abilities. This was true for the ability to select the "Best Choice",  $F(1, 309) = 36.83$ ,  $p < .001$ ,  $\eta_p^2 = .11$ . This finding indicates that the EIT program helped increase knowledge of how to most effectively respond to others who are dealing with emotionally challenging situations. This effect was also present for the ability to select

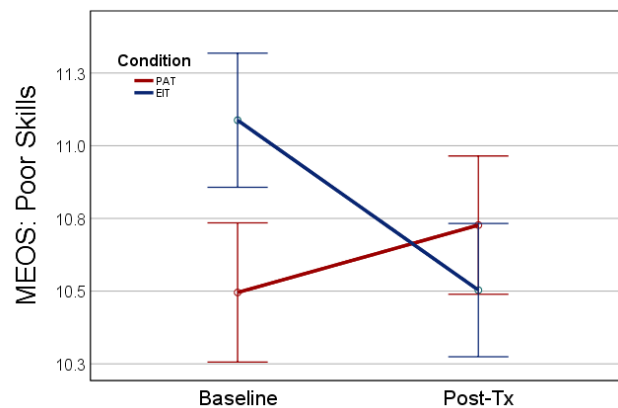
the most effective response as one's personal choice,  $F(1, 309) = 56.71, p < .001, \eta_p^2 = .16$ . This strong effect indicates that the EIT program not only increased the knowledge of how to effectively respond to others, but it also increased the likelihood that participants would actually implement the most effective response. Overall, these findings indicate that the EIT program helps build interpersonal affect regulations skills that will allow participants to maintain healthy interpersonal relationships.

*Managing Emotions of Others:* To supplement the ability-based assessment of interpersonal emotion regulation skills, we also administered the self-reported Managing Emotions of Others Scale (MEOS: (Austin & O'Donnell, 2013)). The MEOS contain subscales reflecting an individual's tendencies to improve others' mood (Enhance), worsen other's moods (Worsen), conceal emotions from others, behave in inauthentic ways for self-serving purposes, use diversion to improve others' moods, or lack skills needed to improve other's feelings. Our results showed that the lack of skill subscale decreased between baseline and post-training to a greater extent in the EIT group,  $F(1, 319) = 8.08, p = .005, \eta_p^2 = .03$ . Participant in the EIT group also reported significantly lower tendencies to conceal their emotions from others,  $F(1, 319) = 6.83, p = .009, \eta_p^2 = .02$ , or use diversion strategies,  $F(1, 319) = 4.95, p = .029, \eta_p^2 = .01$  (Figure 38).

*Mindfulness.* The EIT training incorporated many aspects of mindfulness-based stress reduction and mindfulness research. Although mindfulness is a theoretically distinct approach from EI, they do overlap a great deal. Mindfulness is thought enhance critical emotional abilities such as noticing and non-judgmentally observing thoughts and feelings, accepting negative feelings, and regulating emotions (Miao et al., 2018). Additionally, we incorporated several components of mindfulness



**Figure 37.** Changes in knowledge of the most effect way to manage another person's emotions (top) and tendencies to choose the most effective response (bottom) as a function of program condition and time.

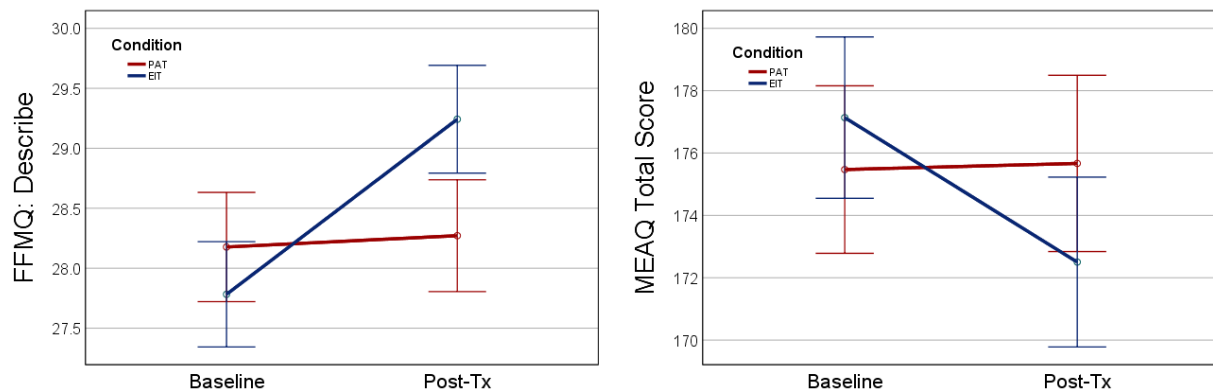


**Figure 38.** Changes in perceptions of poor social-emotional skills as a function of program condition and time. Lower scores indicate that a person feels more confident in their abilities to improve others' feelings.

training into some of the lesson content. We would therefore expect that the EIT program would enhance mindfulness.

**Dispositional Mindfulness:** We administered the Five-Facet Mindfulness Questionnaire (FFMQ: (Baer et al., 2008) to measure individuals' tendencies to engage in mindfulness practices. The FFMQ measures five facets of mindfulness: observation, description, awareness of actions, non-judgement, and non-reactivity to negative emotions. Results showed that participants in the EIT program showed greater improvements to their ability to describe the qualities of their experiences,  $F(1, 319) = 8.00, p = .005, \eta_p^2 = .02$  (**Figure 39 left**). They also showed statistically marginal improvements in their ability to observe using present-focused attention,  $F(1, 319) = 3.85, p = .051, \eta_p^2 = .01$ , and non-judgmentally accept thoughts and feelings,  $F(1, 319) = 2.81, p = .095, \eta_p^2 = .01$ .

**Experiential Avoidance:** We also assessed behavioral mindfulness tendencies using the Multidimensional Experiential Avoidance Questionnaire (MEAQ: (Gamez et al., 2011)). This questionnaire assesses tendencies to avoid distress and negative emotions rather than non-judgmentally accepting and observing them. We found a significant time x program interaction such that participants in the EIT program tended to report fewer avoidant tendencies following training,  $F(1, 316) = 4.84, p = .029$ .



**Figure 39.** Changes in abilities to describe experiences (left) and tendencies to avoid negative and/or distressing feelings (right) as a function of program condition and time.

**Resilience:** The ultimate goal of the training program is to build the emotional skills that promote resilience. To assess whether the program did improve resilience, we administered a number of resilience measures, including the Dispositional Resilience Scale, Connor-Davidson Resilience Scale (CD-RISC), and the Grit Scale. Contrary to hypothesis, we did not find significant *program x time* interactions for any of these scales,  $ps = .197, .660$ , and  $.121$  respectively.

### **Remote Sample (Online Replication Study After COVID-19 Pandemic)**

To provide further validation of the EIT program's efficacy, we attempted to replicate key *time x program condition* interactions in the remote, post-COVID sample. The key time x program interaction for the MSCEIT total scores did replicate,  $F(1, 2014) = 13.63, p < .001, \eta_p^2 = .12$ . As shown in **Figure 40**, participants in the EIT program increased their MSCEIT scores by about 5

points, which was the same degree of improvement experienced in the original sample. Once again, the EIT program seemed to have a stronger effect on the strategic area of EI,  $F(1, 104) = 11.97, p = .001, \eta_p^2 = .10$ , more so than the experimental area,  $F(1, 104) = 2.39, p = .125, \eta_p^2 = .02$ . In this sample, we also found significant improvements to the managing branch of EI,  $F(1, 104) = 7.87, p = .006, \eta_p^2 = .07$ .

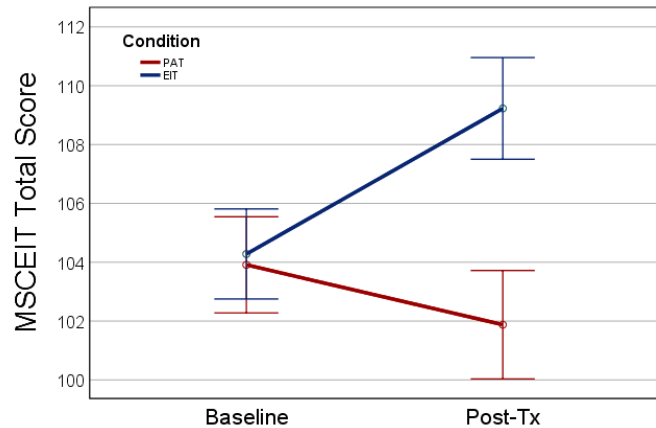
The other main ability-based findings (the LEAS, and IPART) also replicated, providing further evidence that the EIT program is effective at building critical EI skills. The self-reported findings did not replicate, however, showing null results for the TEIQue, SREIS, and DERS total scores. The MAIA total score was only marginally significant in the replication sample, but many the specific subscales that were significant in the original sample (noticing, emotional awareness, self-regulation) were also significant in the replication sample,  $ps = .018-.036$ . **Table 4** shows a comparison of these results between the original sample and the replication sample.

**Table 4.**

*Comparison of Findings Between the Original and Replication Samples.*

	Original Sample (In-Person)	Replication Sample (Remote)	Replicated?
<b>MSCEIT Total</b>	$F(1, 316) = 6.82, p = .009, \eta_p^2 = .02$	$F(1, 104) = 13.63, p < .001, \eta_p^2 = .12$	<b>Yes</b>
<b>TEIQ Total</b>	$F(1, 319) = 3.89, p = .050, \eta_p^2 = .01$	$F(1, 104) = .14, p = .713, \eta_p^2 = .00$	<b>No</b>
<b>SREIS Total</b>	$F(1, 319) = 21.41, p < .001, \eta_p^2 = .06$	$F(1, 104) = 1.96, p = .165, \eta_p^2 = .02$	<b>No</b>
<b>LEAS Total</b>	$F(1, 259) = 7.05, p = .008, \eta_p^2 = .03$	$F(1, 104) = 12.49, p < .001, \eta_p^2 = .11$	<b>Yes</b>
<b>MAIA Total</b>	$F(1, 319) = 8.72, p = .003, \eta_p^2 = .03$	$F(1, 104) = 3.74, p = .056, \eta_p^2 = .04$	<b>Partial</b>
<b>DERS Total</b>	$F(1, 318) = 7.67, p = .006, \eta_p^2 = .02$	$F(1, 104) = .32, p = .574, \eta_p^2 = .00$	<b>No</b>
<b>IPART BC</b>	$F(1, 309) = 36.83, p < .001, \eta_p^2 = .11$	$F(1, 104) = 5.55, p = .020, \eta_p^2 = .05$	<b>Yes</b>
<b>IPART PC</b>	$F(1, 309) = 56.71, p < .001, \eta_p^2 = .16$	$F(1, 104) = 9.63, p = .002, \eta_p^2 = .09$	<b>Yes</b>

**Hypothesis 1 Conclusion:** We found support for our hypothesis that the EI Training Program would produce significantly greater enhancement of EI scores (and related constructs) compared to the matched Placebo Training Program. Individuals in the EIT program consistently showed improvements across a variety of social-emotional skills. They showed improvements on the key constructs of ability-based and self-reported EI. They also showed greater levels of improvements on specific skills including emotional awareness, emotion regulation, interpersonal affect regulation, and mindfulness. The effects of training of EI abilities also replicated in a second, smaller sample. These results are encouraging and provide good evidence for the efficacy of the EIT program.



**Figure 40.** Changes to Ability-Based EI as a function of time and program condition in the online replication sample.

***Hypothesis 2.*** *We hypothesize equivalence (or non-inferiority) among the administration durations, which would argue in favor of using a shorter administration time without loss of efficacy.*

A second goal of the current task was to determine the most effective administration duration (i.e., providing a 1-week short duration to complete all tasks or a 3-week expanded duration to complete the same tasks). Research on learning and retention suggests that distributing practice over longer periods tends to be more effective for long-term information retention (Cepeda et al., 2006). However, the longer time period may increase the rates of individuals do not finish the program. We therefore wanted to compare the effect of program duration on program efficacy, program perceptions, and retention.

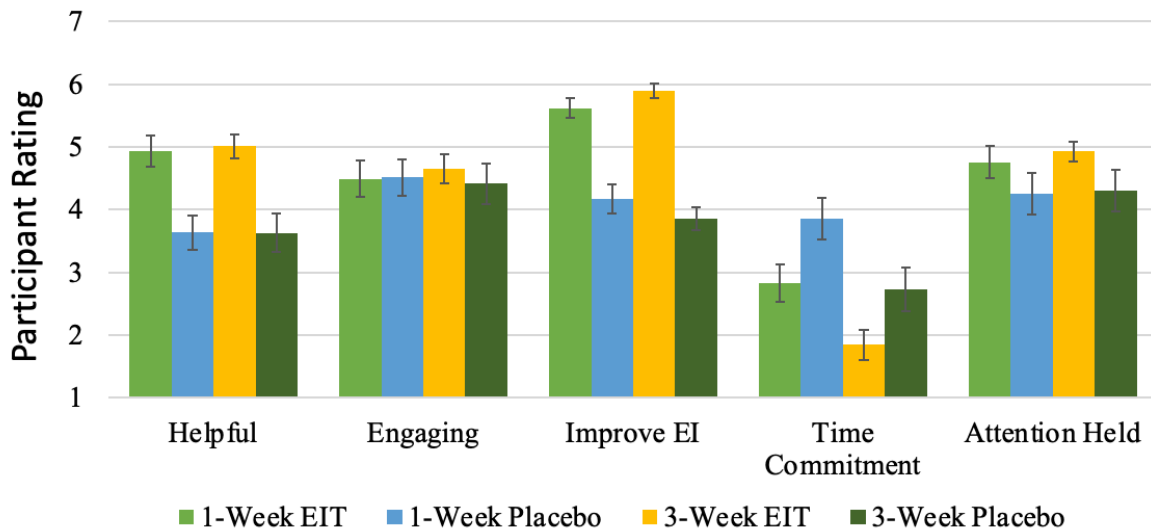
The onset of the COVID-19 pandemic also allowed us to investigate an unplanned comparison in administration format. The original study design had participants following a strict schedule, and participants were removed from the study if they deviated from or fell behind that schedule. Once the pandemic started, we instituted a more flexible policy in which participants could complete the program anytime within a three-week period. We therefore compared strict vs flexible administration to determine whether the formats were equivalent.

Comparisons of Program Efficacy: To examine whether there was a more effective length of training, we conducted 2 (1-week, 3-week) x 2 (EIT, PAT) x 2 (Baseline, Post-Training) mixed repeated measures ANCOVA for each of the major EI measures (MSCEIT, TEIQue, SREIS) in the original in-person sample. Only the SREIS perceiving subscale showed a significant difference,  $F(1, 315) = 10.32, p = .001$ , such that the effect of the EIT program was stronger in the distributed training schedule. No other significant effects were observed, with p-values ranging from  $p = .165-.991$ . We therefore conclude that the distribution of training did not affect the post-training outcomes.

Comparisons of the effects between the structured schedule (i.e., the in-person sample) and the flexible administration format (i.e., the remote sample) were previously described in the results for hypothesis 1 (see **Table 4**). We found comparable changes to MSCEIT total scores. The SREIS and TEIQue total scores were significant in the structured schedule sample, but non-significant in the flexible group. However, the unique influence of COVID-19 on the flexible administration sample makes it difficult to confidently interpret these findings. It is possible that these null findings were unrelated to the actual training, and instead were more closely related to general declines in perceptions of self-worth, increased negative affect, and demands on cognitive resources produced by the pandemic. Self-reported trait measures appear more sensitive to these sorts of factors than ability-based ones (Matthews et al., 2015; Paulhus & Vazire, 2007). More research will be needed to definitively answer the question of whether flexible versus structured training program administration has a differential effect on improvements to self-reported EI.

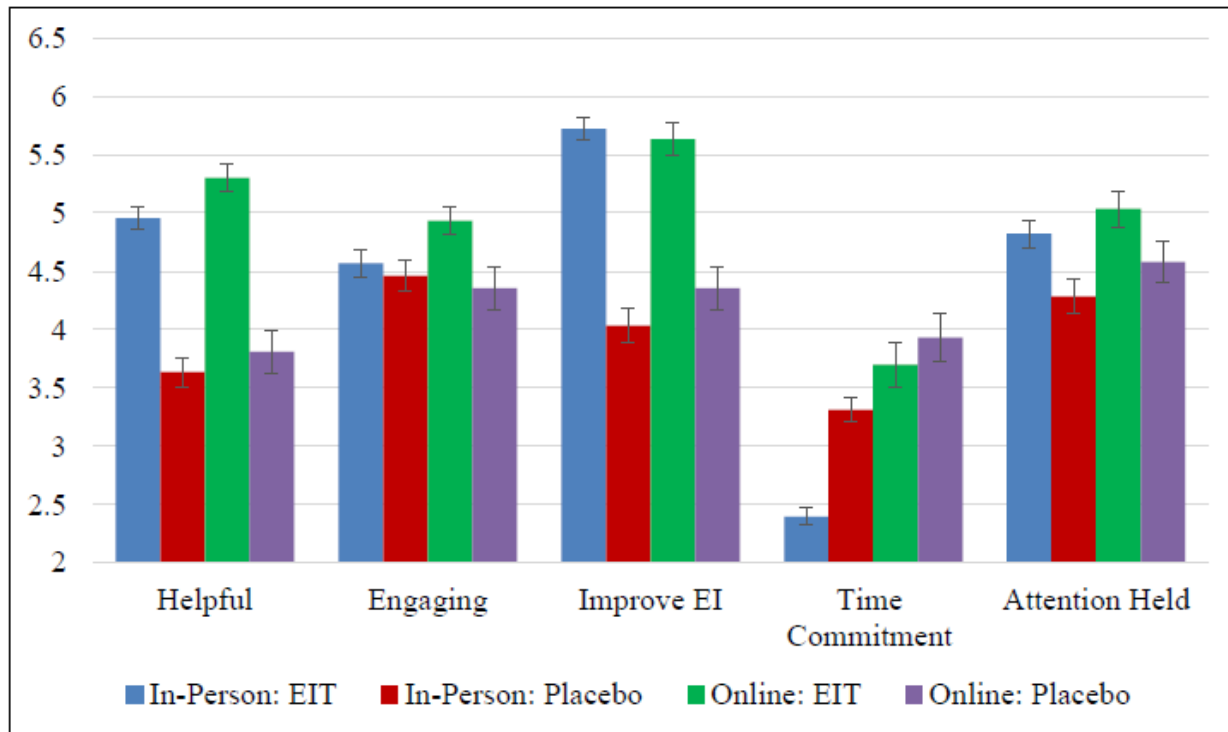
Comparisons of Subjective Preferences: In addition to comparing the efficacy of the program between administration formats, we also examined how the administration timing affected program perceptions. Our earlier analysis suggested that participants in the EIT program viewed the program quite favorably overall and there were significant differences in ratings between the EIT and PAT programs (see **Figure 41**). Our more detailed analyses revealed that there were main

effects of program. However, there were no significant differences between the 1-week and 3-week administration formats in perceptions of helpfulness, engagement, motivation to improve EI, or program ability to hold attention for both the EIT program ( $ps = .677-.985$ ) and PAT program ( $ps = .552-.999$ ). The only significant difference we found was that 1-week administration format was viewed to be more time consuming than the three-week administration format (see **Figure 41**). This was true when comparing within the EIT group,  $t(144) = 5.08, p < .001$ , and the PAT group,  $t(154) = 3.98, p < .001$ . It appears that spreading the lessons out over a longer time period led participants to perceive the program as less of a time commitment.



**Figure 41.** Comparison of program perceptions between the EIT and Placebo, 1-week and 3-week administrations.

We also examined how the increased flexibility of the training schedule affected participants' perceptions of the program. We continued to ask participants in the remote sample to report on their perceptions of their assigned program, and this allowed us to examine whether there were any differences between in-person (who completed the training using a fixed schedule) and remote samples (who completed the training using a flexible schedule). We found that, similar to the in-person sample, participants in the EIT program had higher levels of perceived helpfulness and motivation to improve EI relative to those in the Placebo program. We also found that, on average, the remote sample tended to report equal or higher levels of perceived helpfulness, engagement, attention, and motivation to improve compared to the in-person sample. See **Figure 42** for comparisons. Interestingly, participants in the online sample reported a higher time commitment relative to the in-person sample. We would have thought that providing the flexibility for participants to do the program whenever they were able would have reduced the perceived time commitment. An in-depth analysis of the program metadata revealed a possible reason – when allowed to complete the program on their own schedule, participants tended to complete more lessons in a single timeframe and had a longer median completion time. In future research, we plan to examine the role of lesson timing as a potential influence on training perceptions and skill development.



**Figure 42.** Comparison of program perceptions between the EIT and Placebo, structured and flexible administrations.

Comparisons of Attrition Rates: The empirical support we have found for this EI training program is ultimately meaningless if people are unable to actually complete the training. This is especially relevant as our target demographic, active-duty military personnel, are extremely busy with the demands of work and military life. We therefore compared attrition rates between conditions. Attrition was defined as anyone who discontinued the study between their baseline and post-training assessments. This could be due to voluntary withdraw, being a no show, or being removed for non-compliance. In the structured schedule administration format, participants were removed if they did not adhere to their given 1-week or 3-week schedule. In the flexible administration format, participants were removed if they did not complete their training by the end of the three-week period.

**Table 5** shows attrition rates across the different administration formats. To statistically compare these rates, we conducted a logistic regression with program assignment, program timing, and program structure predicting binary completion (0 = discontinued; 1 = completed post-training assessment). There was a significant difference overall between the administration formats,  $\chi^2(3) = 28.32$ ,  $p < .001$ . In more particular terms, there was a significant effect of program duration, with

**Table 5**  
*Comparison of Attrition Rates Between Administration Formats*

Group	Attrition Rate
1-Week Structured EIT	16%
1-Week Structured PAT	22%
3-Week Structured EIT	39%
3-Week Structured PAT	30%
3-Week Flexible EIT	8%
3-Week Flexible PAT	16%

higher levels of attrition in the three-week condition,  $p < .001$ . There was also a significant effect of program structure,  $p < .001$ , with lower levels of attrition in the flexible format when compared to the structured format.

**Hypothesis 2 Conclusion:** We found no significant differences in program efficacy as a function of program distribution. Participants assigned to the 1-week and 3-week distributions both appeared to benefit for EI training, leading us to conclude that the distribution of training did not affect the post-training outcomes. Participants in the flexible administration format also showed comparable increases to their ability EI. All administration formats were perceived similarly in terms of helpfulness, engagement, motivation, and attention, regardless of administration format. The only main difference was that the three-week structured format was perceived to be the least time consuming.

We did find that administration format had a significant effect on our ability to retain participants throughout the course of the study. The 3-week structured format had extremely high rates of attrition. It appears that it is very difficult for people to stick to a strict schedule for that long, and we have concerns that we may have lost some participants who could have otherwise greatly benefited from the program. The 3-week flexible format had much lower rates of attrition (8% vs 39% for EIT, 16% vs 30% for PAT). We therefore concluded that allowing participants to complete the training program on their own time would help improve the accessibility and generalizability of the program. Moving forward, we decided to adopt the 3-week flexible format.

***Hypothesis 3. It is hypothesized that the changes in EI scores observed at the immediate post-training assessment will be sustained at 6-month follow-up for the subsample providing such assessments.***

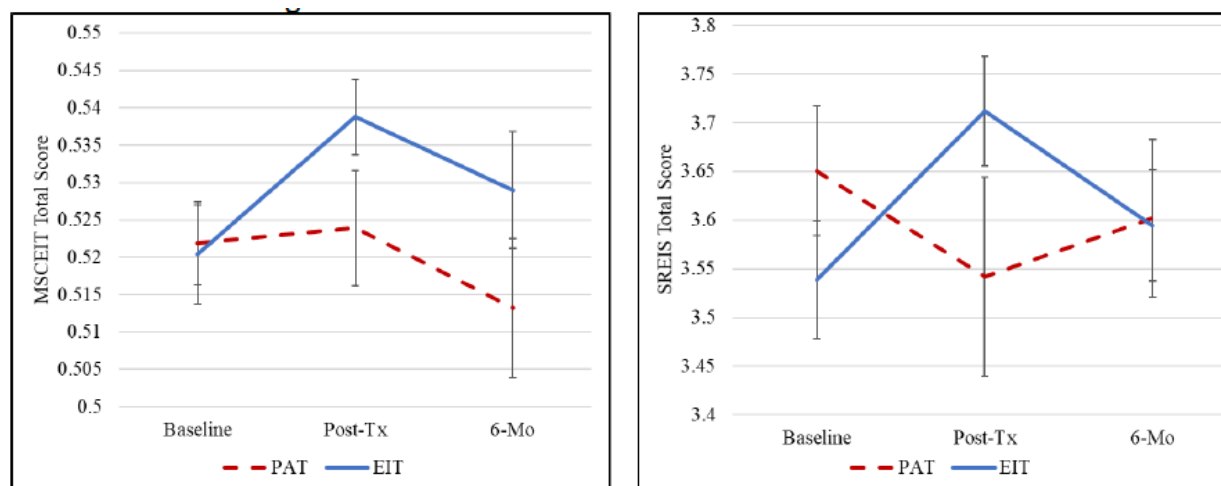
As the final component of the Task 3 study, we wanted to examine whether the EI abilities gained during the training were retained long-term. We expected to see that performance-based metrics of EI (e.g., the MSCEIT) would still be elevated six months following training. We did not have strong hypotheses about trait EI scores, as traits are fairly resistant to long-term change (McCrae & Costa, 1994).

**Retention of EI Skills:** As initially designed, Tsk 3 included a 6-month follow-up to assess the long-term retention of skills learned in the EIT Program. Unfortunately, the six-month follow-ups for the in-person sample were scheduled to begin after the start of the COVID-19 pandemic, and changes to the protocol and the general climate in which the participants completed the assessments made the EI scores difficult to compare across timepoints. Nonetheless, did find support for our hypothesis. Critically, as shown in **Figure 43**, improvements to ability-based EI did persist over the long term, despite the challenges of the pandemic,  $F(2, 170) = 3.66, p = .029$ . This effect also replicated in the remote sample, who did all assessments after the start of the pandemic,  $F(2, 154) = 4.53, p = .012, \eta_p^2 = .06$ . In both samples, participants increased their MSCEIT scores by approximately 5 points, and remained approximately 2.5 points above their baseline scores six months later.

The two self-reported measures of EI (SREIS & TEIQue), which would theoretically be more resistant to long-term change, initially increased but returned to baseline in the in-person sample



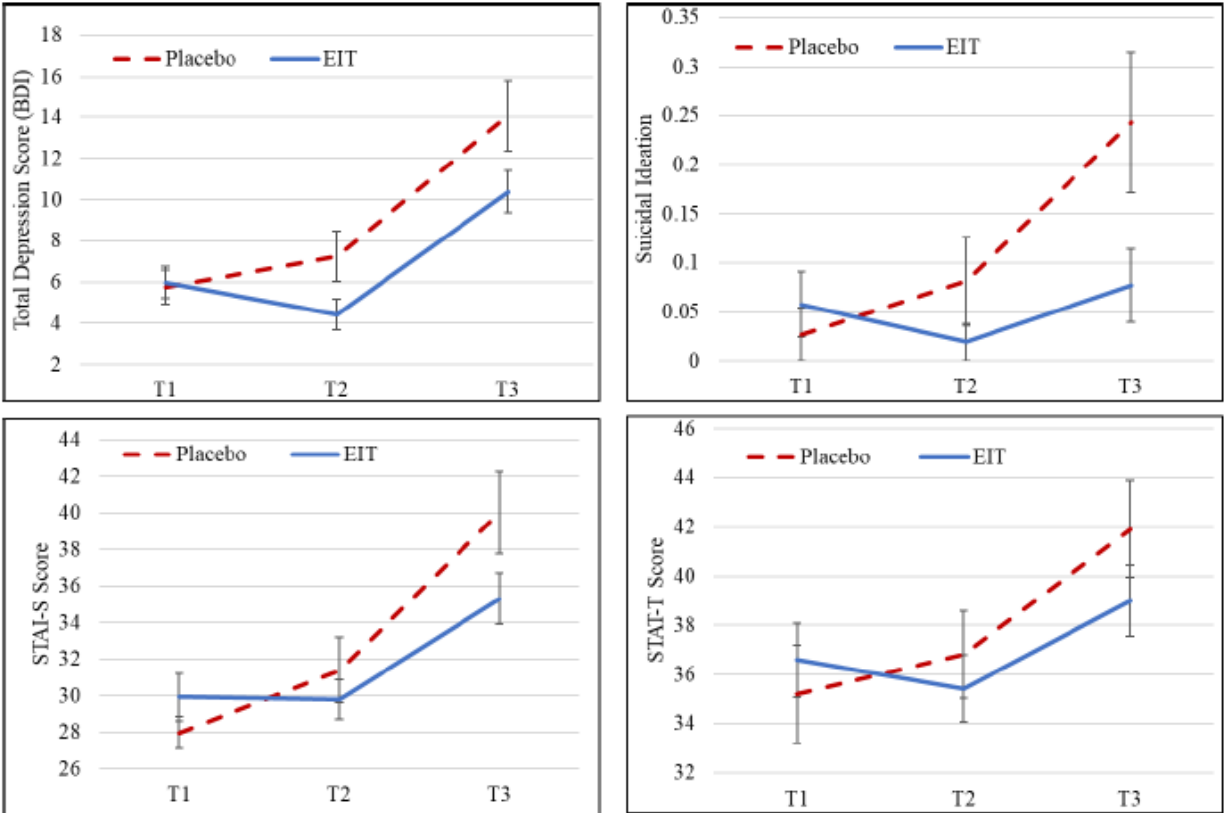
(see **Figure 43**). It is possible that participants immediately felt more confident and efficacious while taking EI training, but then drifted back to their typical baseline levels once they were removed from the EI training context. Future research may want investigate ways to prolong the effects of EI training on trait EI (e.g., refresher courses).



**Figure 43.** Long term retention of EI in the in-person sample. Participants retained elevated levels of ability-based EI (left), but self-reported EI levels returned to baseline levels (right).

**Long-Term Benefits of EI Training:** As mentioned above, our planned six-month follow-ups for the in-person sample were interrupted by the COVID-19 pandemic. Although this was undesirable from a planning perspective, it also granted us a unique opportunity to examine whether the EIT Program could have a protective effect during a period marked by high levels of stress, uncertainty, and negative emotions. The timing of the study was such that the first two assessments (baseline and post-training) occurred prior to the pandemic, and the last assessment (6-month follow-up) occurred following the onset of the pandemic, giving us a real-world opportunity to test the effectiveness of the EIT Program for promoting resilience and mental health. We found that this EIT Program did serve a protective factor against the stresses of the pandemic. As shown in **Figure 44**, participants in the EIT program showed *lower levels of depression*,  $F(2, 174) = 3.60, p = .029$ , *suicidal ideation*,  $F(2, 174) = 3.79, p = .024$ , and *state anxiety*,  $F(2, 174) = 4.19, p = .017$ . There was also a marginally significant effect for trait anxiety,  $F(2, 174) = 3.04, p = .050, \eta^2 = .03$ . These results are quite encouraging for the usefulness of the EIT for bolstering resilience and protecting mental health during times of stress and adversity. More details can be found in (Persich et al., 2021).

**Hypothesis 3 Conclusion:** We found support for our hypothesis that improvements to EI abilities would still be evident six months following the training. Ability EI scores measured by the MSCEIT increased immediately following training and remained elevated above baseline six-months later. We also found support for the notion that EI training would produce long-term benefits in mental health, as EI training appeared to help individuals more adaptively navigate the challenges of the COVID-19 pandemic.



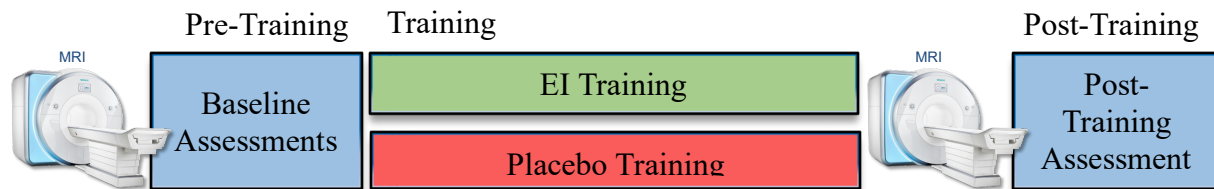
**Figure 44.** Changes in depression (top left), suicidal ideation, (top right), state anxiety (bottom left), and trait anxiety (bottom right) as a function of time and program condition. The COVID-19 pandemic began between T2 and T3. Figure from Persich et al., 2021.

**Task 3 Conclusion:** In Task 3, we sought to conduct a large-scale efficacy study to demonstrate whether the EIT program would actually improve emotional skills compared to a matched placebo program in a large sample from the general population. We found strong and consistent evidence for the program’s efficacy. Relative to the matched placebo awareness training, the EIT program produced reliable and meaningful improvements to performance-based EI abilities, self-reports of EI, emotional awareness, interoceptive awareness, inter- and intra-personal emotion regulation, mindfulness, and mental health outcomes. The effects of the program on performance-based ability EI replicated in a second sample and improvements were still present six months following the EI training. Moreover, the EIT program was successful in protecting the mental health and wellbeing of individuals during the highly stressful and unanticipated onset of the COVID-19 pandemic, leading to a reduction in suicidal thinking, depression, and anxiety compared to those who received the placebo program. These results are extremely encouraging and point to the utility of the EIT program for building core emotional skills.

### 3.4 TASK 4: Neuroimaging Study

**Overview:** Task 3 established that the EI training program was effective at increasing EI and other critical social-emotional abilities. The Task 4 study aimed to extend that work by investigating the neurobiological mechanisms underlying the observed changes in EI resulting from the training program. Specifically, we examined whether improvement of EI would be associated with meaningful changes in the magnitude of activation of primary emotion regulation neurocircuitry. This study was designed to address *Specific Aim #2: Identify the neural mechanisms underlying the observed changes in EI abilities.*

This present study design largely paralleled the efficacy study described in Task 3, with the only difference being the addition of neuroimaging scans before and after training. **Figure 45** illustrates the Task 4 study design. Participants completed a 90-minute neuroimaging scanning session at the University of Arizona's Biosciences Research Laboratory facility. Afterwards, they were asked to complete a set of baseline assessments. These assessments were identical to those completed by the Task 3 remote sample described above. Once participants had completed their baseline assessments, they were randomly assigned to either the EIT program or the matched placebo awareness training program (PAT). Participants were allowed to complete the training on their own schedule, so long as they fully completed the training within *three weeks*. Upon completion



**Figure 45.** Diagram of the study design. Participants did a baseline scanning session and completed their baseline assessments. They were then randomly assigned to either the EI or placebo training program. After completing the training, participants returned for a second scanning session, after which they did a post-training assessment session.

of the training, participants returned for a second 90-minute scanning session that was identical to baseline, and then completed a set of post-training assessments.

**Neuroimaging Details:** Participants underwent a 90-minute series of neuroimaging scans. Head movements were restricted using expandable foam cushions. After an automated scout image was acquired and shimming procedures performed to optimize field homogeneity, a T1-weighted three-dimensional MPRAGE sequence (TR/ TE/ flip angle = 2.1s/2.33ms/12°), yielding 176 sagittal slices (256 × 256 matrix) with 50% distance factor between slices, and a voxel size of 1 × 1 × 1 mm was collected for spatial normalization, positioning the slice prescription, and for subsequent morphometric analysis. Functional MRI images (blood oxygenation level dependent or BOLD; (Kwong et al., 1992)) was acquired using a gradient echo T2\*-weighted sequence (TR = 2000 msec, TE = 36 msec, flip angle = 90°). Prior to each scan, four images were acquired and discarded to allow longitudinal magnetization to reach equilibrium. The T1, T2, and gradient-echo functional images were collected in the same plane (whole brain acquisition; axial slices angled perpendicular to the AC-PC line) with the same slice thickness (2 mm, 10% distance factor; voxel

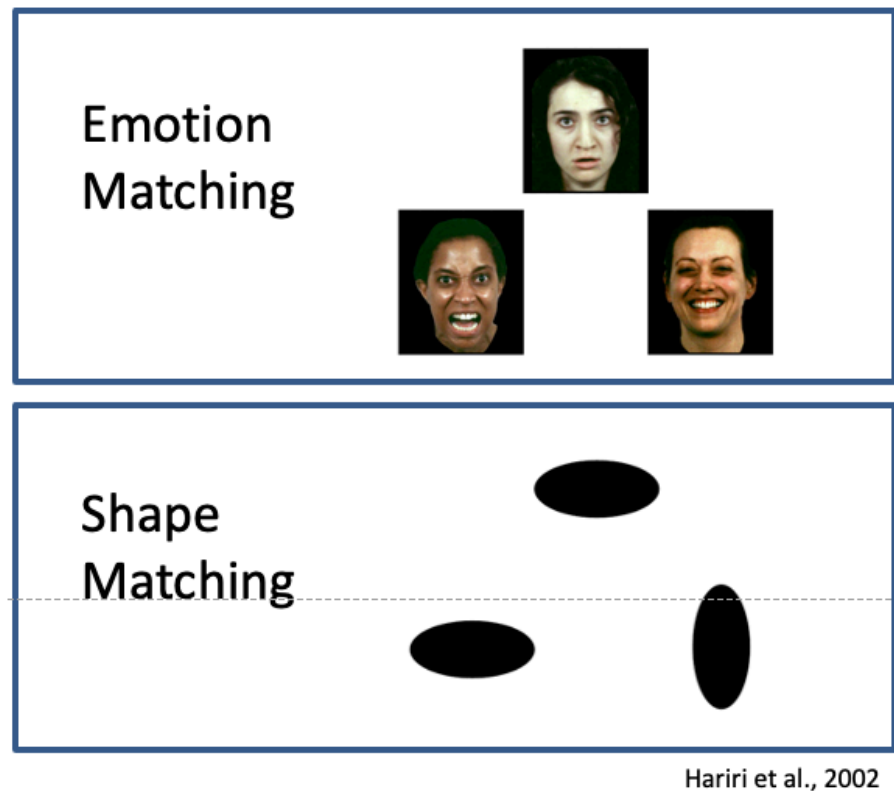
size 2 x 2 x 2 mm), excitation order (interleaved) and phase encoding (head-to-foot). During fMRI, participants completed the Emotional Facial Affect Matching Task (EFAT; **Figure 46**).

#### Emotional Facial Affect Matching Task (EFAT).

To assess emotional processing, we used a task developed by Hariri and colleagues (Hariri et al., 2002). During this task, participants were either shown stimuli containing faces with angry, fearful, or happy emotional expressions; or they were shown geometric shapes as a control. In each trial, participants were asked which of the two stimuli at the bottom of the screen matched the stimulus at the top of the screen. Participants responded by pressing one of two buttons on the MRI scanner button box that correspond to the side of the screen of the correct match. Participants were exposed to a total of 24

matching trials which each included 12 geometric stimuli, 3 matched angry stimuli, 3 matched fearful stimuli, 3 matched happy stimuli, and 3 fixation points. There are a total of three blocks containing a combination of the potential stimuli conditions. An example trial illustrated in **Figure 46**. This task lasted approximately 406 seconds. This task has been found to activate the amygdala (Barch et al., 2014; Hariri et al., 2002) and demonstrates moderate reliability across time (Manuck et al., 2007). Participants underwent fMRI scanning throughout the duration of the task to allow assessment of the brain regions that show significant activation changes associated with the evaluation of emotional expressions on faces.

**Sample Description:** Participants were recruited from the University of Arizona and the surrounding Tucson metropolitan area. Participants were recruited through flyers, listserv emails, and advertisements in newspapers, Facebook, and Instagram. A total of  $n = 70$  participants completed the baseline scans and assessment sessions. This study had very good retention rates, with  $n = 69$  participants fully completing the training, post-training scans, and post-training assessments. **Table 6** presents the demographic characteristics of the sample at the baseline and post-training assessment scans.



**Figure 46.** Example trial of the conditions of the Emotional Facial Affect Matching Task (Hariri et al., 2002). Top: participants were asked to indicate which of the two emotional expressions on the bottom matched target emotion on the top. Bottom: The control task required the participant to match the direction of one of the two ovals on the bottom to the target oval on the top.

**Table 6**  
*Characteristics of Participants at Baseline and Post-Training*

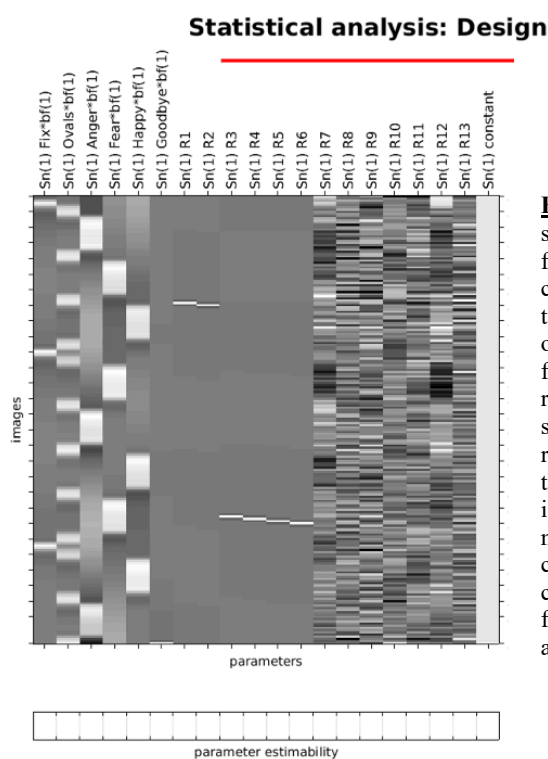
	<b>Baseline <i>n</i> = 70</b>	<b>Post-Training <i>n</i> = 69</b>
<b>Age</b>	<i>M</i> = 26.77 (7.02)	<i>M</i> = 26.70 (7.04)
<b>Gender</b>		
Male	36%	65%
Female	64%	35%
<b>Ethnicity</b>		
White	71%	71%
Black or African American	1%	1%
Native American or Alaska Native	3%	3%
Asian	1%	1%
Native Hawaiian or Pacific Islander	0%	0%
Latino or Hispanic	13%	13%
More than one race	7%	7%
Other	1%	1%
Prefer not to answer	1%	1%
<b>Randomization</b>		
EIT	47%	46%
PAT	53%	54%

***Analyses:***

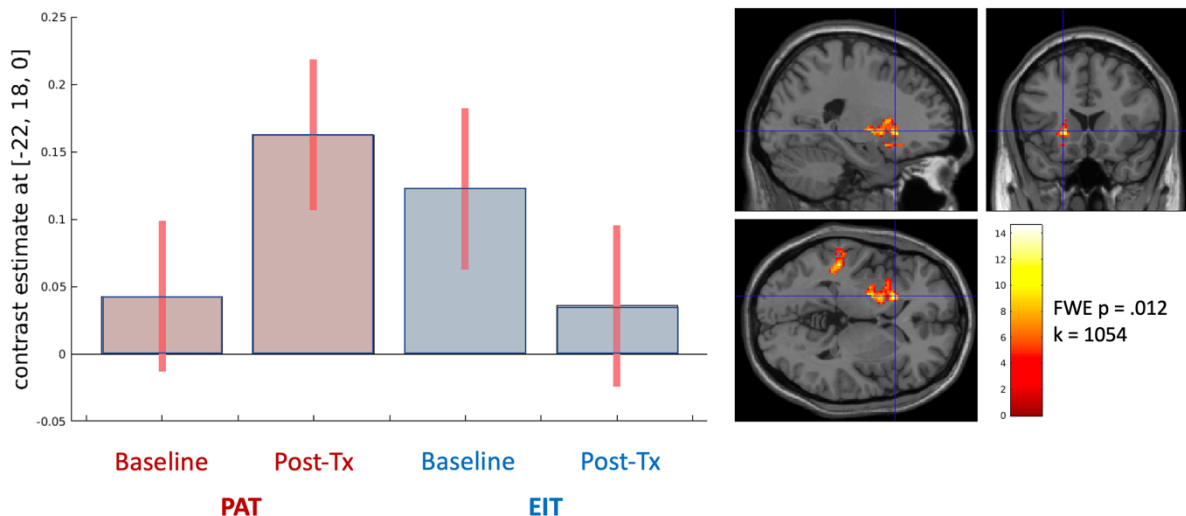
**EFAT:** The data from the EFAT task were pre-processed and analyzed using Statistical Parametric Mapping (SPM12)(Wellcome Department of Cognitive Neurology, London, UK; <http://www.fil.ion.ucl.ac.uk/spm>). Raw functional images were first preprocessed by realigning and unwarping the functional images, and then co-registering the newly created mean functional image to each subject's structural T1 scan. Forward deformation fields were used to normalize the images from subject native space to Montreal Neurological Institute (MNI) coordinate space. Finally, the images were spatially smoothed (6 mm full-width at half maximum), and resliced to 2 x 2 x 2 mm voxels. A high pass filter with a 128 second cut-off period was used to remove low frequency confounds. The standard canonical hemodynamic response function in SPM was employed, and serial autocorrelation was corrected with an autoregressive model of 1 (+white noise). Motion artifacts exceeding 3 SD in mean global intensity and scan-to-scan motion that exceed 1.0mm were regressed out using the Artifact Detection Tool ([http://www.nitrc.org/projects/artifact\\_detect/](http://www.nitrc.org/projects/artifact_detect/)). On an individual basis, a general linear model (GLM) was specified to create a design for each condition, including the fixation, oval comparisons, anger comparisons, fear comparisons, and happy comparisons. This model also included the participant specific regressors for movement and global intensity (see **Figure 47**). For the primary analyses reported here, we specified a contrast between all emotion comparisons (i.e., anger, fear, and happy) versus the control task (oval comparisons) contrast activation between the two-back > zero-back condition. Once computed for all participants, these contrast images

were entered into a second-level random-effects mixed factorial analysis with 2 between groups conditions (EIT versus PAT) and 2 within-subjects conditions (pre- versus post-training).

The first analysis undertaken was an omnibus repeated measures analysis to examine the possible interaction effect between training condition (EIT versus PAT) and session (pre- versus post training). This was computed using the flexible factorial model within SPM12. For significance, we used a cluster correction approach to correct for multiple comparisons. Essentially, we set a standard threshold for the peak height of activation and then conducted cluster extent (i.e., volume) correction for the number of voxels required for significance. When corrected for multiple comparisons at the most stringent level (i.e.,  $p < .001$  uncorrected height, and FWE correction at  $p < .05$  for voxel extent), this model failed to show a significant interaction effect. However, at a slightly more liberal correction threshold ( $p < .05$  height, FWE  $p < .05$  correction for extent), we found a significant cluster ( $k = 1054$  voxels) within the left hemisphere that included regions of the basal ganglia and insular



**Figure 47.** Individual subject-level design matrix for the EFAT. The first columns on the left reflect the conditions (fixation, ovals, anger, fear, and happy faces), the middle columns reflect the scans with significant artifact, and the rightmost columns reflect the motion and global signal intensity covariates in the model. Individual specific contrasts were then computed and carried forward into the second level analyses.



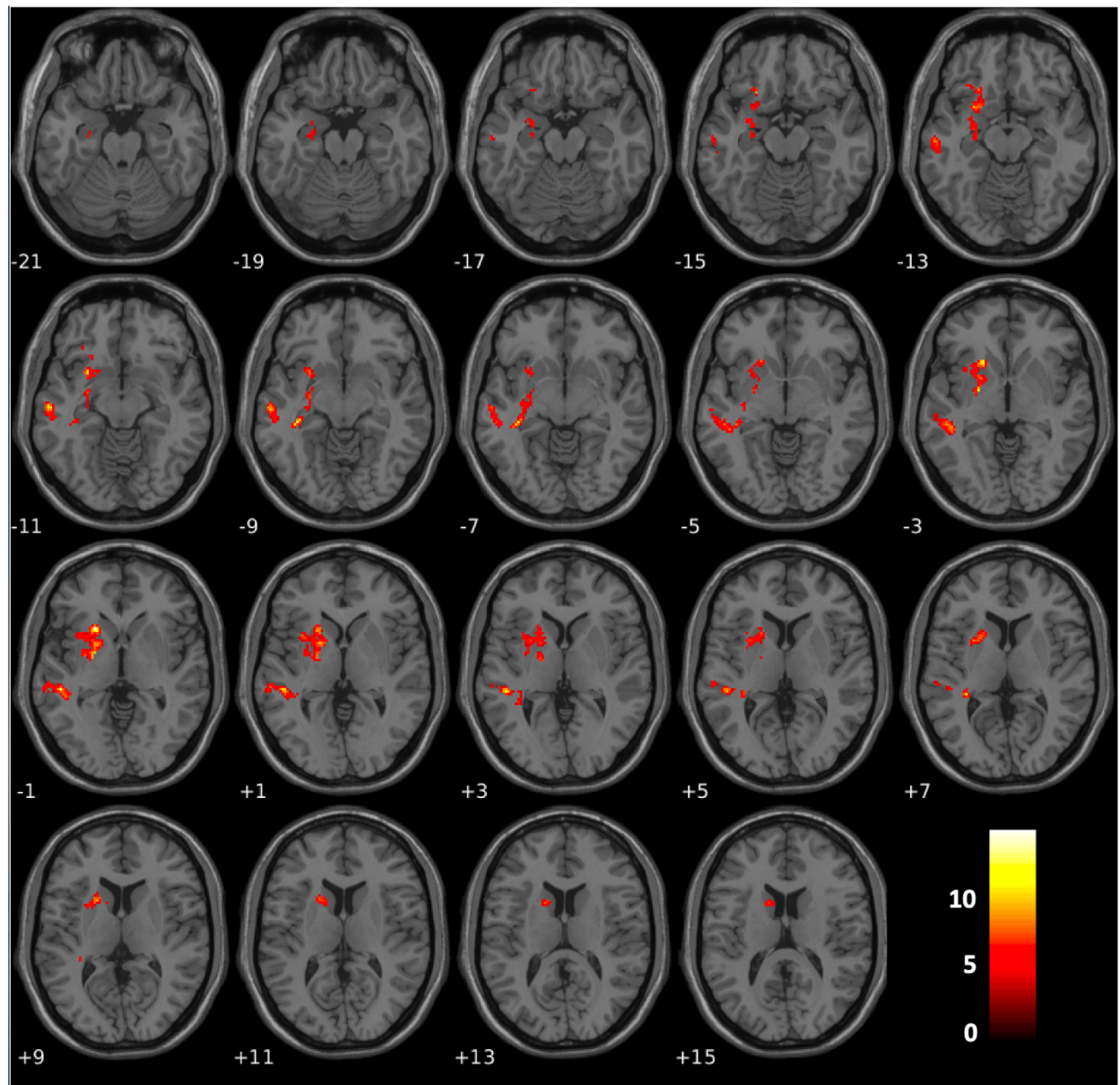
**Figure 48.** Results from the omnibus repeated measures analysis for the 2 (training condition) x 2 (assessment session) flexible factorial interaction at FWE  $p < .05$  cluster correction. The figure shows that there was an interaction effect within a large cluster ( $k = 1054$  voxels) that included the left hemisphere basal ganglia, insula, and hippocampus. Individuals who received the placebo training (PAT) showed an increase while those who receive the emotional intelligence training (EIT) showed a decrease for the comparison between the emotion comparison and control conditions of the EFAT.



cortex that appeared to decrease more for those who received the EIT program while the PAT group showed increases (see **Figure 48 and 49**).

**Statistics: *p*-values adjusted for search volume**

cluster-level				peak-level					mm mm mm		
$p_{\text{FWE-corr}}$	$q_{\text{FDR-corr}}$	$k_{\text{E}}$	$p_{\text{uncorr}}$	$p_{\text{FWE-corr}}$	$q_{\text{FDR-corr}}$	$F$	$(Z_{\equiv})$	$p_{\text{uncorr}}$			
<b>0.012</b>	<b>0.013</b>	<b>1054</b>	<b>0.000</b>	<b>0.996</b>	<b>0.999</b>	<b>14.59</b>	<b>3.54</b>	<b>0.000</b>	<b>-22</b>	<b>18</b>	<b>0</b>
				1.000	0.999	12.40	3.25	0.001	-50	-32	0
				1.000	0.999	12.27	3.23	0.001	-38	-30	-8



**Figure 49.** Axial image montage for the omnibus repeated measures analysis for the 2 (training condition) x 2 (assessment session) flexible factorial interaction at FWE  $p < .05$  cluster correction. The figure shows that there was an interaction effect within a large cluster ( $k = 1054$  voxels) that included the left hemisphere basal ganglia, insula, and hippocampus.



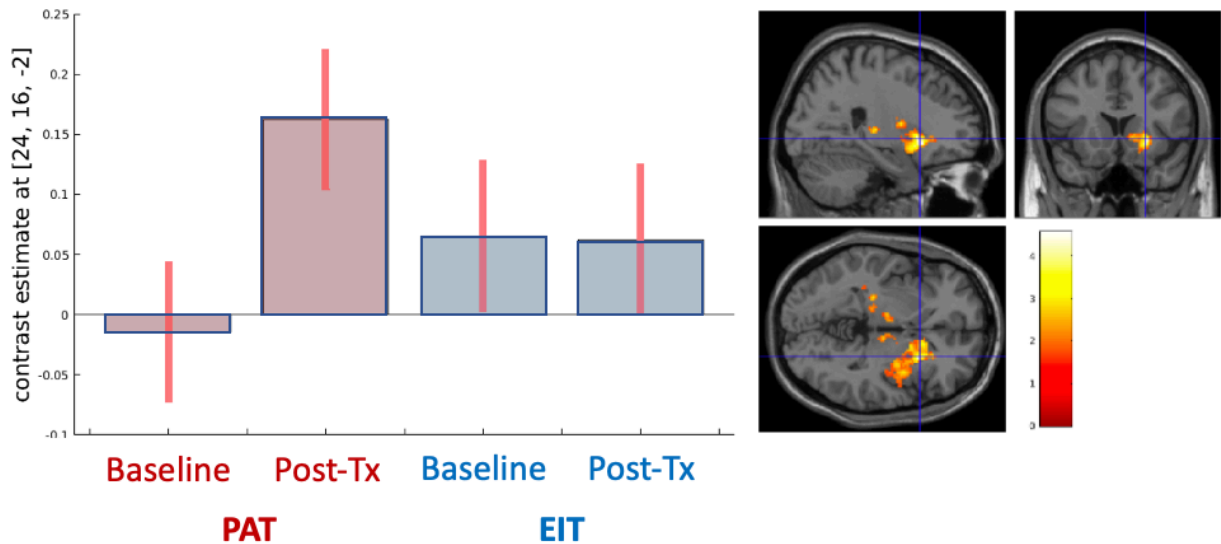
To more directly examine the potential effects of EIT on changes in brain activation, we conducted planned comparisons among each potential contrast in the previous ANOVA model.

**Baseline Differences Between PAT and EIT:** Next, we isolated our analysis to the baseline session and compared the brain responses between the PAT and EIT groups using the more liberal threshold described above ( $p < .05$  height, FWE  $p < .05$  correction for extent). There were no regions that showed significantly greater activation for the EIT condition compared to PAT at baseline. Similarly, there were no regions that were more active for the PAT group relative to the EIT group at baseline. Thus, it can be assumed that the two conditions were similar in responses to the EFAT at baseline.

**PAT Pre-Post Changes:** First, isolating our analysis to the PAT group, we compared the change in brain responses from pre-to post training using the more liberal threshold described above ( $p < .05$  height, FWE  $p < .05$  correction for extent), we found no significant declines from pre-to-post treatment. However, there was a significant increase in activation of the right hemisphere subcortical regions including the basal ganglia, while no change was observed in these regions for individuals who underwent EIT (see **Figure 50**).

**Statistics: *p*-values adjusted for search volume**

set-level		cluster-level				peak-level					mm mm mm		
<i>p</i>	<i>c</i>	<i>p</i> <sub>FWE-corr</sub>	<i>q</i> <sub>FDR-corr</sub>	<i>k</i> <sub>E</sub>	<i>p</i> <sub>uncorr</sub>	<i>p</i> <sub>FWE-corr</sub>	<i>q</i> <sub>FDR-corr</sub>	<i>T</i>	( <i>Z</i> )	<i>p</i> <sub>uncorr</sub>			
<b>0.000</b>	<b>2</b>	<b>0.001</b>	<b>0.001</b>	<b>2869</b>	<b>0.000</b>	<b>0.232</b>	<b>0.415</b>	<b>4.56</b>	<b>4.39</b>	<b>0.000</b>	<b>24</b>	<b>16</b>	<b>-2</b>
						0.981	0.999	3.70	3.61	0.000	-4	-10	6
						0.990	0.999	3.65	3.55	0.000	28	-28	6
		<b>0.002</b>	<b>0.001</b>	<b>2470</b>	<b>0.000</b>	<b>0.661</b>	<b>0.984</b>	<b>4.13</b>	<b>4.00</b>	<b>0.000</b>	<b>-4</b>	<b>-16</b>	<b>24</b>
						0.736	0.984	4.07	3.94	0.000	-8	-32	26
						0.846	0.984	3.96	3.84	0.000	8	-14	28

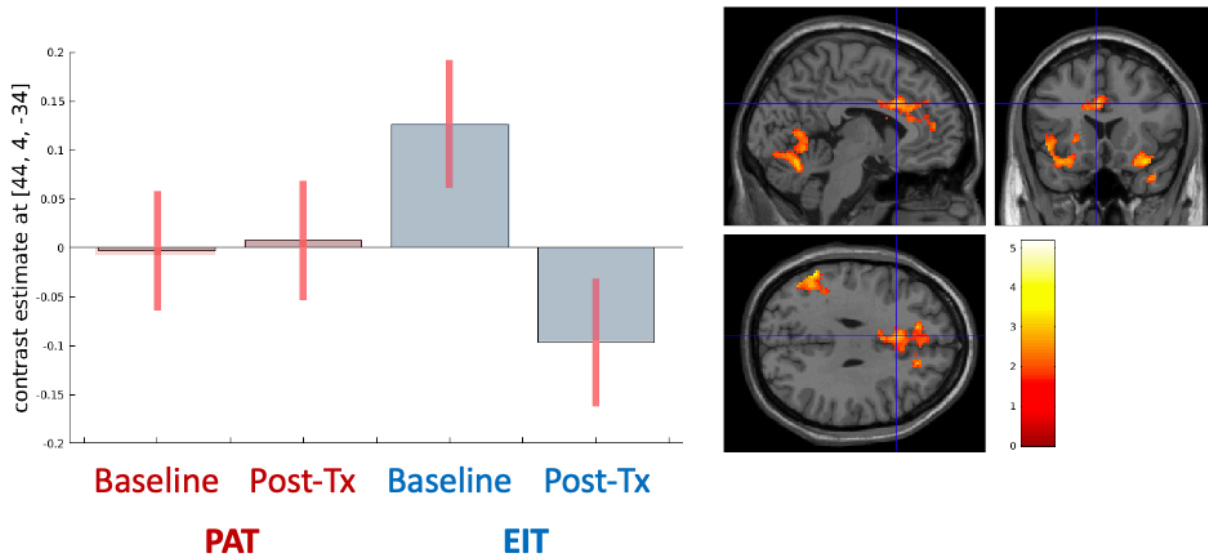


**Figure 50.** Results from the t-test comparison showing increased responsiveness for the placebo condition that was greater after training than before training. This change was not observed for those in the emotional intelligence training (EIT) group.

**EIT Pre-Post Changes:** Next, isolating our analysis to the EIT group, we compared the change in brain responses from pre-to post training using the more liberal threshold described above ( $p < .05$  height, FWE  $p < .05$  correction for extent). As shown in **Figure 51**, this analysis revealed that there was a significant decline in several clusters throughout the brain between pre-to-post training in the EIT group, but no significant reduction in activation for those in the PAT group. Perhaps the most notable area of deactivation for the EIT group after training was in the dorsal anterior cingulate gyrus, a region of the brain's salience network is often associated with executive function, learning, and emotional processing, and which is often hyperactivated in patients with post-traumatic stress disorder (PTSD). This finding suggests that training in emotional intelligence skills may specifically alter functioning of this critical emotional hub, perhaps through greater efficiency of other brain systems and greater emotional expertise when confronted with images of emotional faces. This hypothesis remains to be explored more extensively.

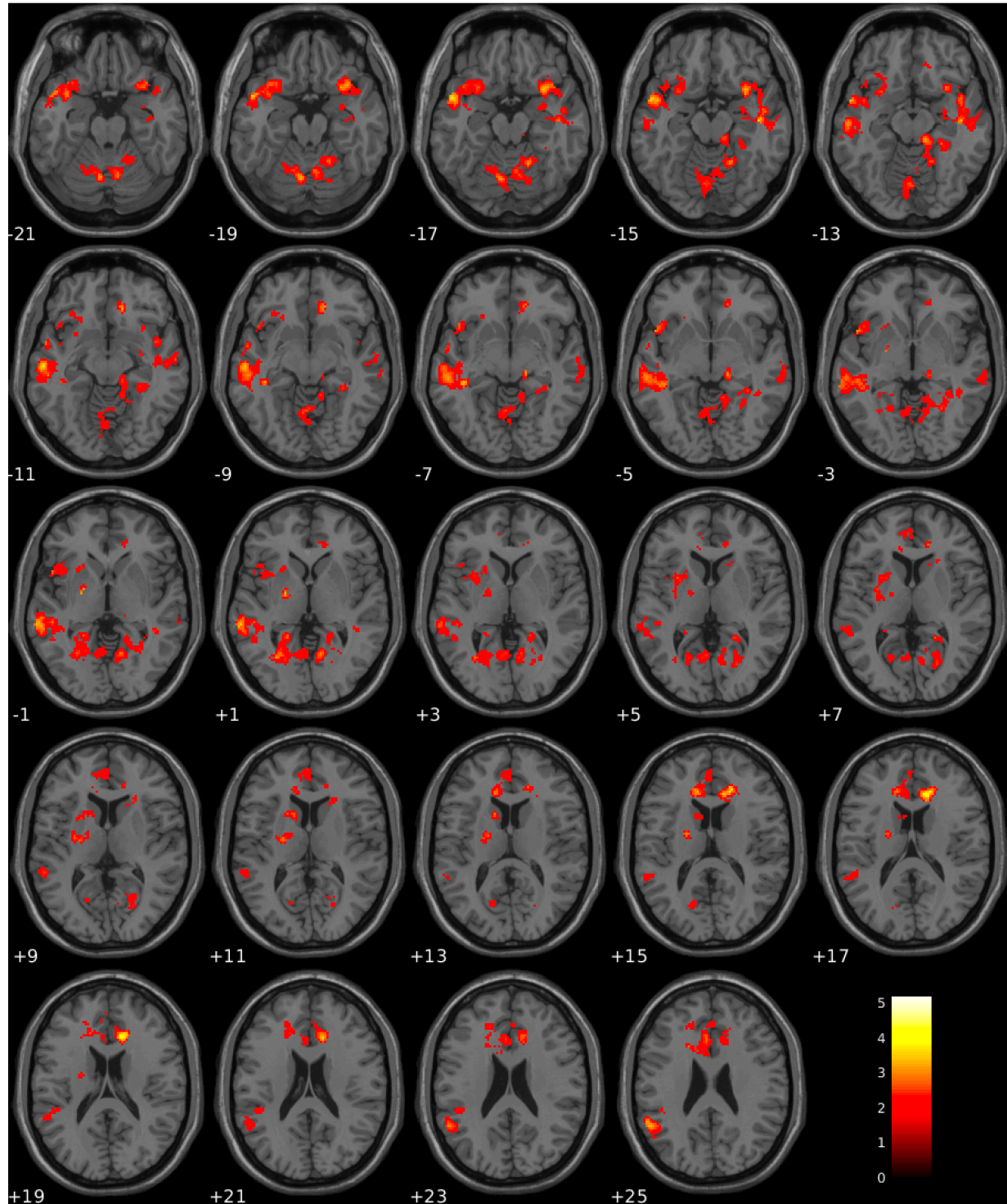
**Statistics: *p-values adjusted for search volume***

set-level		cluster-level				peak-level					mm mm mm		
$p$	$c$	$p_{\text{FWE-corr}}$	$q_{\text{FDR-corr}}$	$k_E$	$p_{\text{uncorr}}$	$p_{\text{FWE-corr}}$	$q_{\text{FDR-corr}}$	$T$	$(Z_{\text{=}})$	$p_{\text{uncorr}}$			
<b>0.000</b>	<b>5</b>	<b>0.165</b>	<b>0.044</b>	<b>1104</b>	<b>0.001</b>	<b>0.028</b>	<b>0.099</b>	<b>5.16</b>	<b>4.92</b>	<b>0.000</b>	<b>44</b>	<b>4</b>	<b>-34</b>
						0.997	1.000	3.56	3.48	0.000	42	-14	-14
						1.000	1.000	3.34	3.27	0.001	30	14	-16
						<b>0.636</b>	<b>1.000</b>	<b>4.16</b>	<b>4.02</b>	<b>0.000</b>	<b>12</b>	<b>30</b>	<b>18</b>
		<b>0.075</b>	<b>0.032</b>	<b>1321</b>	<b>0.001</b>	0.933	1.000	3.83	3.73	0.000	-14	36	32
						1.000	1.000	3.25	3.18	0.001	12	34	-10
						<b>0.974</b>	<b>1.000</b>	<b>3.73</b>	<b>3.63</b>	<b>0.000</b>	<b>-58</b>	<b>-18</b>	<b>-10</b>
						0.995	1.000	3.60	3.51	0.000	-58	-50	30
		<b>0.114</b>	<b>0.037</b>	<b>1207</b>	<b>0.001</b>	1.000	1.000	3.41	3.34	0.000	-62	-34	2
						<b>0.983</b>	<b>1.000</b>	<b>3.69</b>	<b>3.60</b>	<b>0.000</b>	<b>-52</b>	<b>6</b>	<b>-16</b>
						1.000	1.000	3.44	3.36	0.000	-48	12	-22
						1.000	1.000	3.25	3.18	0.001	-32	2	-32
		<b>0.008</b>	<b>0.009</b>	<b>1994</b>	<b>0.000</b>	<b>1.000</b>	<b>1.000</b>	<b>3.17</b>	<b>3.11</b>	<b>0.001</b>	<b>-8</b>	<b>-66</b>	<b>-18</b>
						1.000	1.000	3.17	3.11	0.001	-30	-64	2
						1.000	1.000	3.15	3.09	0.001	14	-24	-6



**Figure 51.** Results from the t-test comparison showing a reduction in responsiveness for the EIT group following training than before training. This change was not observed for those in the placebo training (PAT) group.

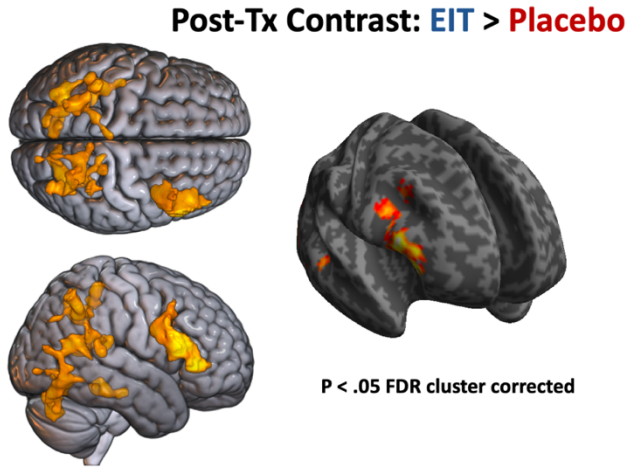
While the dorsal anterior cingulate region was one region that was particularly deactivated, we also found that this pattern was evident in numerous other areas including the regions of the temporal poles, inferior temporal region, amygdala, insular cortex (see **Figure 52**). These are all regions that are well known to respond to emotional stimuli at a basic level. This raises the



**Figure 52.** Results from the t-test comparison showing a reduction in responsiveness for the EIT group following training than before training. This change was not observed for those in the placebo training (PAT) group.

possibility that the EIT program may lead to significant changes in the individual's baseline approach to perceiving and processing emotional stimuli. In contrast, there were no regions showing increases from pre- to post-treatment that survived multiple comparison correction for the EIT condition at the same thresholds.

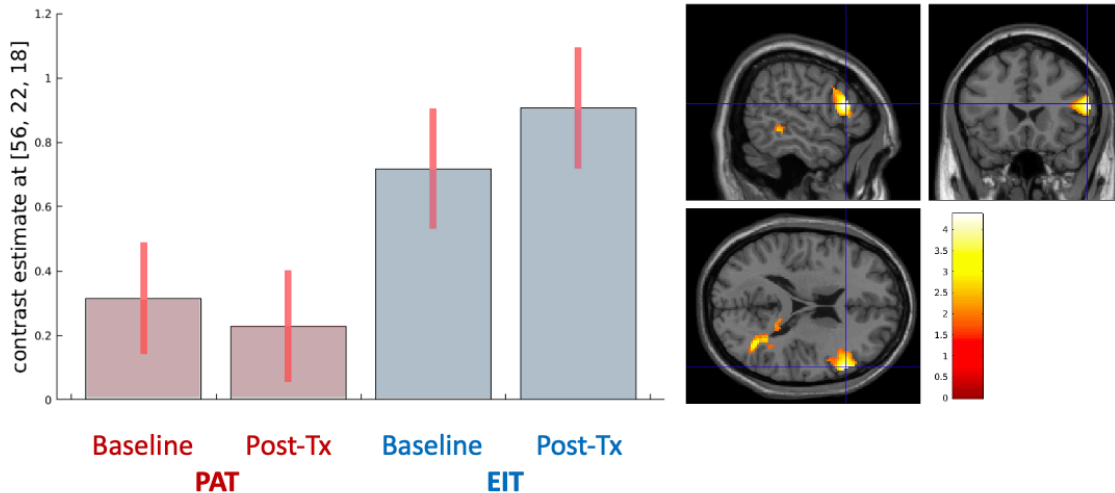
**Post-Treatment Differences Between PAT and EIT:** Finally, isolating our analysis to the post-treatment session, we compared the brain responses between the PAT and EIT groups using the more liberal threshold described above ( $p < .05$  height, FWE  $p < .05$  correction for extent). After 3-weeks of treatment, there were no regions that showed significantly greater activation for the PAT group relative to the EIT group. However, the EIT group showed significantly greater activation in a cluster localized to the right dorsolateral and ventrolateral prefrontal cortex and a second cluster in the posterior regions that included visual regions involved in emotional face processing such as the fusiform face area (FFA). The graphic representations of this region are included in **Figure 53**. The statistics for this analysis are presented in **Figure 54**.



**Figure 53.** Results from the t-test comparison showing greater activation at post-treatment for the EIT group compared to the PAT group. The greatest difference in post treatment activation was in the region of the dorsolateral and ventrolateral prefrontal cortex in the right hemisphere.

**Statistics:  $p$ -values adjusted for search volume**

set-level		cluster-level				peak-level							
$p$	$c$	$p_{\text{FWE-corr}}$	$q_{\text{FDR-corr}}$	$k_E$	$p_{\text{uncorr}}$	$p_{\text{FWE-corr}}$	$q_{\text{FDR-corr}}$	$T$	$(Z_{\equiv})$	$p_{\text{uncorr}}$	mm	mm	mm
0.005	2	0.094	0.037	1260	0.001	0.400	0.352	4.36	4.21	0.000	56	22	18
						0.850	0.782	3.95	3.84	0.000	52	34	2
						0.999	1.000	3.47	3.39	0.000	46	28	14
		0.019	0.015	1716	0.000	0.998	1.000	3.53	3.45	0.000	36	-62	16
						0.999	1.000	3.51	3.43	0.000	40	-36	-16
						1.000	1.000	3.40	3.32	0.000	32	-66	-10

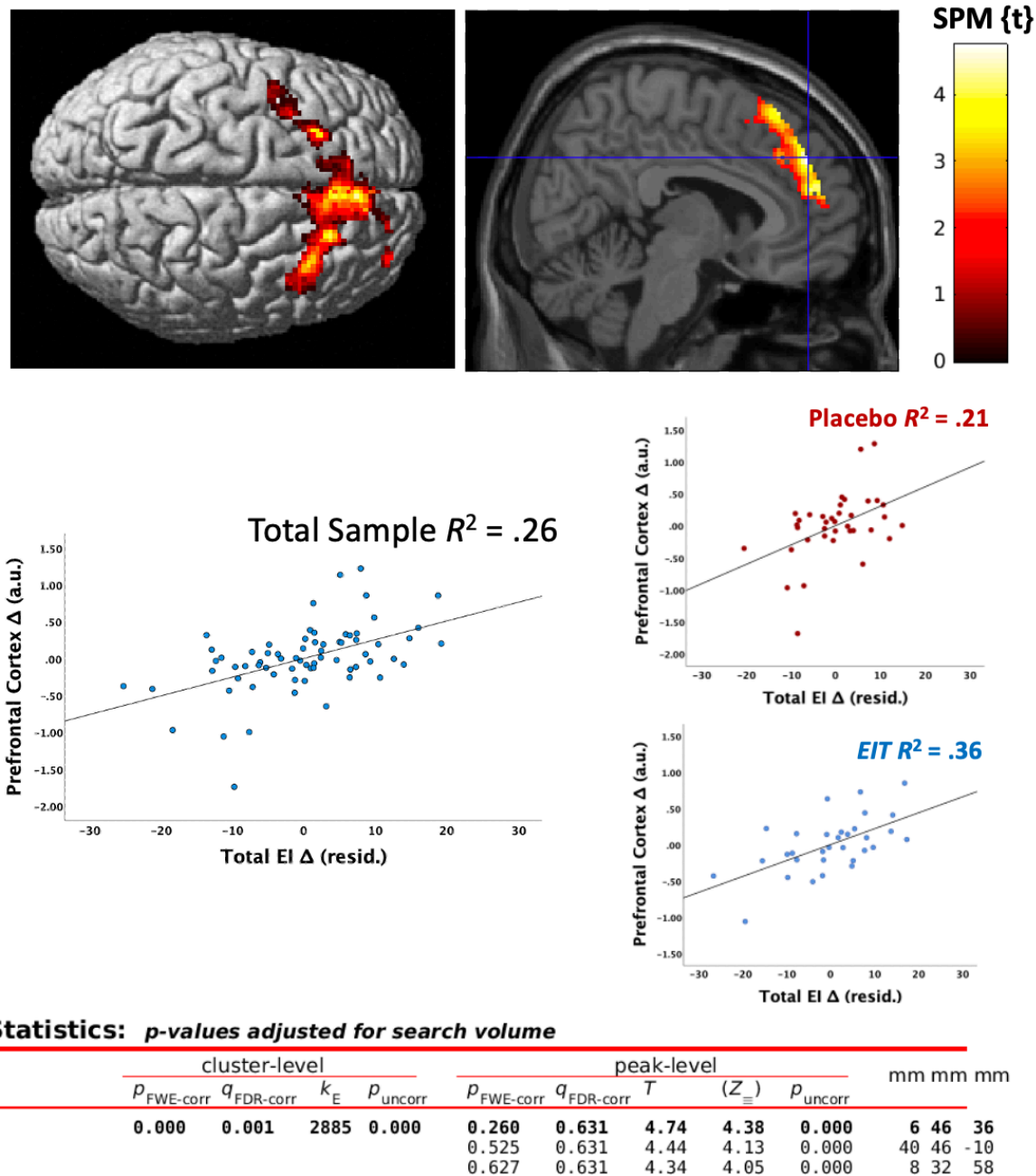


**Figure 54.** Results from the t-test comparison showing greater activation to the EFAT task for the EIT group versus the PAT group following training.

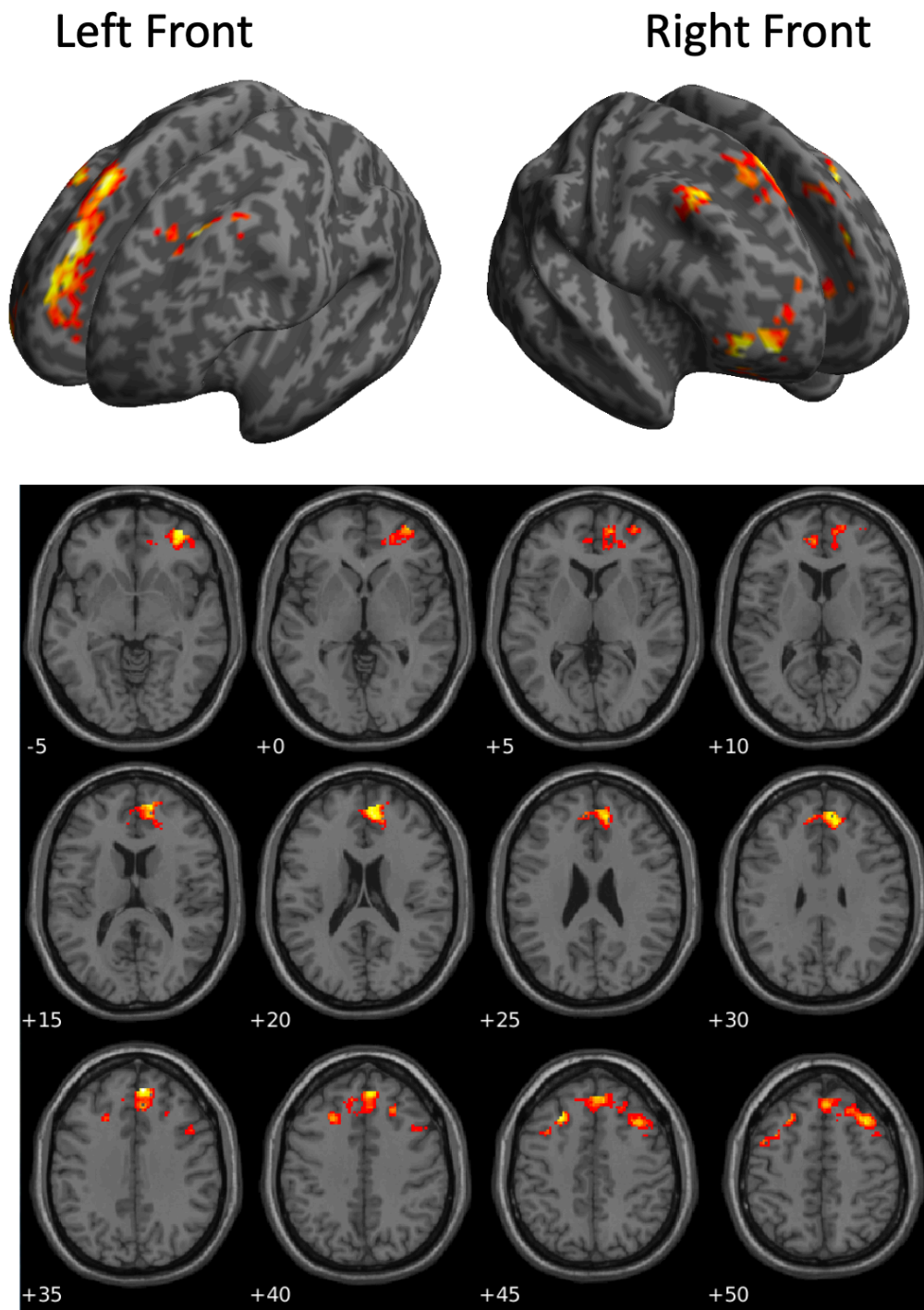


Correlations with Changes in EI: Finally, it was also of interest to examine correlations between the changes in EI observed over the treatment period and corresponding changes in brain activation to the EFAT. This would provide an indication of underlying neural mechanisms associated with improvement in EI skills. To accomplish this, we conducted a multiple regression analysis in SPM12, controlling for age and sex at the liberal threshold described above. The primary outcome is shown in **Figure 55**.

## Correlation with Higher EI



**Figure 55.** Results from the regression analysis showing the brain regions that increased with increasing EI from pre-to-post treatment.



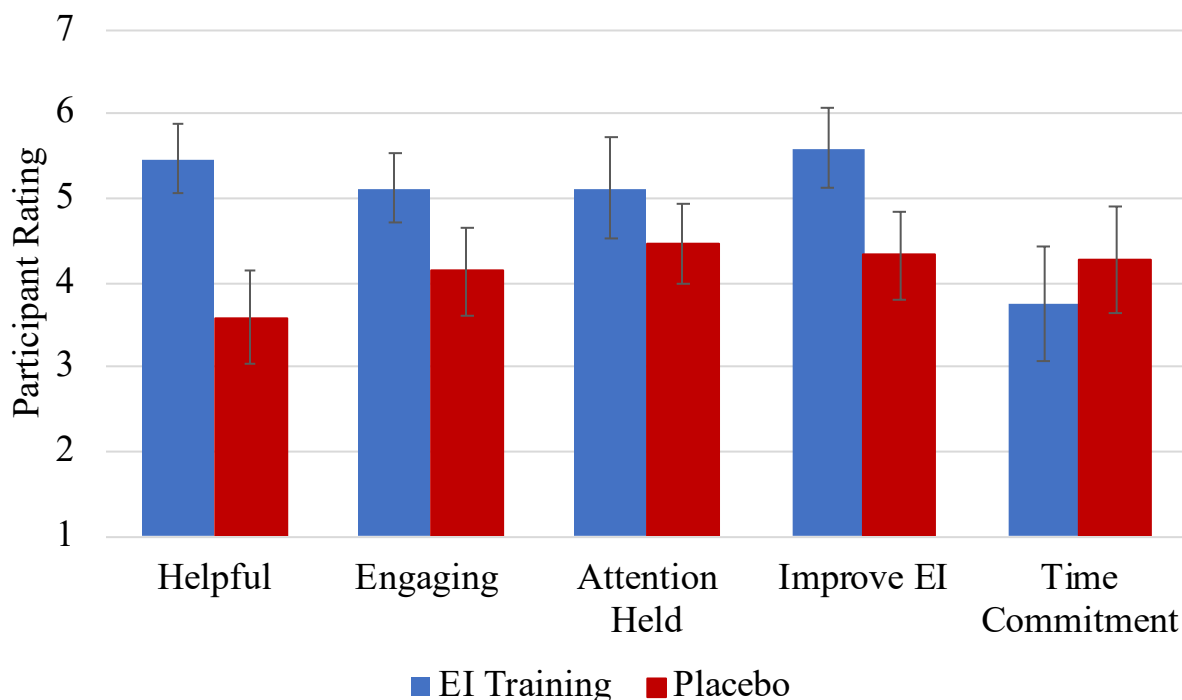
**Figure 56.** Results from the regression analysis showing the brain regions that increased with increasing EI from pre-to-post treatment. The top figure shows frontal lateral views of the activation pattern on an inflated brain. The bottom figure shows axial slices of the primary regions showing the positive correlation between EI and brain activation during the EFAT.

Overall, from results presented in **Figure 55** and **Figure 56**, it is clear that increases in EI from pre-to-post treatment were associated with significant increases in activation responses within the dorsal medial region of the prefrontal cortex and areas corresponding to the premotor cortex

bilaterally. The scatterplots show that both correlations were positive, but that the association was numerically stronger for the EIT group than the PAT group. In contrast, there were no regions that showed significant negative correlations as this level of correction for multiple comparisons.

Together, these findings suggest that not only does the EIT program lead to significant improvements in EI skills, as demonstrated in Task 3 and in the present Task 4 study, but that EI training is also associated with significant changes in emotional regulation and processing systems of the brain. Moreover, improvement in measured EI skills is also associated with increased activation responses within the dorsomedial prefrontal cortex, a region that is critical to the ability to take the perspective of another individual. This is consistent with expectations for the EFAT task, which requires that an individual read the expression of the face and infer the emotional state of the individuals in the photograph. Enhanced activation of the dorsomedial prefrontal cortex and its associated “Theory of Mind” processes would likely contribute to this capacity. This provides further construct validity for the EIT program by linking it with expected neural mechanisms that should underlie successful emotional processing.

**Program Perceptions:** Similar to Task 3, we asked participants to rate their perceptions of the training program upon completing the training. We asked participants to rate the program in terms of how helpful, engaging, motivating, attention holding, and time consuming the program was (1 = not at all; 7 = very). As evident in **Figure 57**, similar to Task 3, participants tended to view the EIT program favorably, with all average ratings being above the midpoint. Participants in the EIT program also perceived the program more favorably than the PAT program, giving higher rating on the dimensions of helpfulness,  $t(67) = 5.32, p < .001$ , engagement,  $t(67) = 2.86, p = .006$ , and motivation to improve EI,  $t(67) = 3.47, p = .001$ . There were no significant differences between



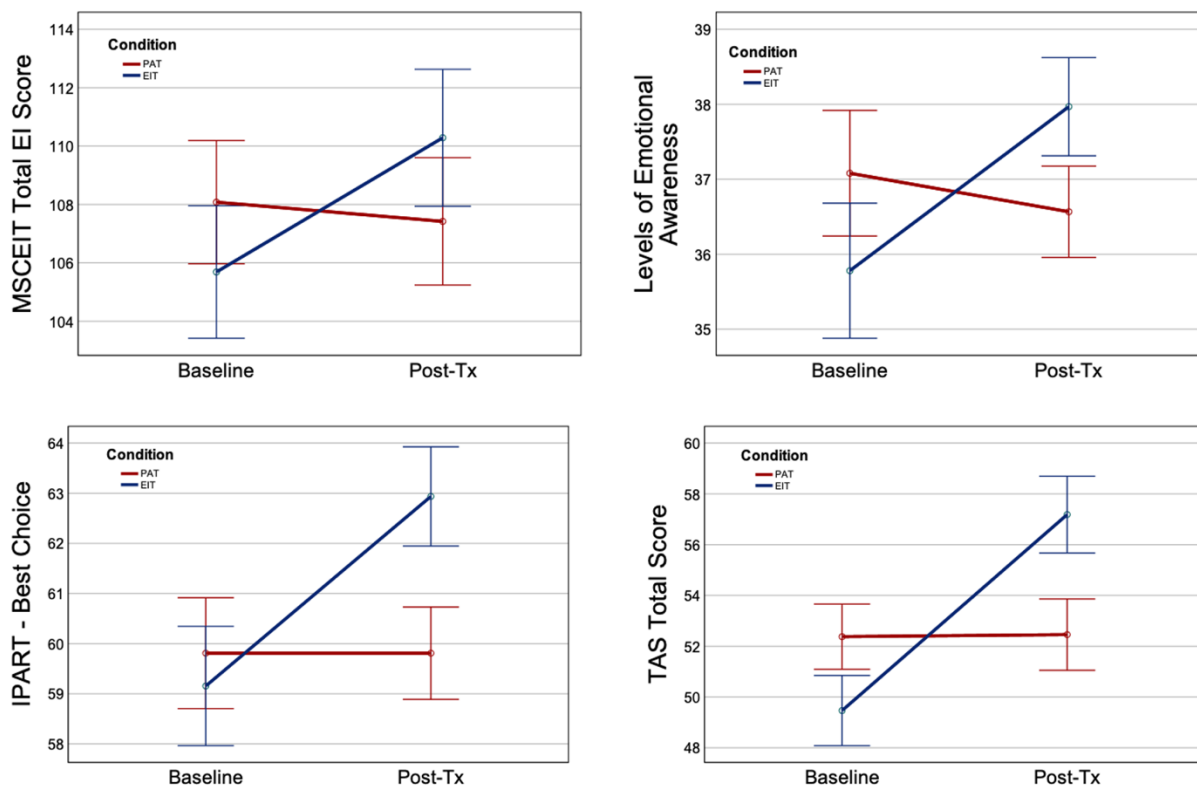
**Figure 57.** Comparison of Program Perceptions for the EI training program and the Placebo Awareness Training in Task 4 (neuroimaging).



programs for ability to hold attention,  $t(67) = 1.73, p = .089$ , or time commitment,  $t(67) = 1.10, p = .274$ .

**Replication of Main Efficacy Results:** Task 4 was not specifically designed to examine the efficacy of the training to increase EI scores and was underpowered to detect core *time x program* interactions. Nonetheless, we wanted to investigate whether we would find similar improvements to EI and emotional abilities in this sample. We conducted a series of 2 (Baseline, Post-Training) x 2 (EIT, PAT) mixed repeated measures ANCOVAs predicting our three main EI metrics (MSCEIT, TEIQue, and SREIS). We also examined two other ability-based measures of emotional ability (LEAS and IPART) that had large enough effect sizes in Task 3 that the present sample would be adequately powered to detect. Similar to Task 3, we covaried for the possible confounds of age, gender, and general intelligence.

Even in this smaller sample, we found that the MSCEIT total score improved more for the EIT than the PAT group,  $F(1, 67) = 5.26, p = .025, \eta_p^2 = .073$ . As shown in **Figure 58**, participants in the EIT condition increased their total MSCEIT scores by 4.60 points, whereas the PAT group's scores stayed relatively the same. This magnitude of change was similar to the improvements observed in the EIT groups for the in-person ( $\Delta = 5.16$ ) and remote samples ( $\Delta = 4.92$ ) from the Task 3 study.



**Figure 58.** Changes to EI and emotional abilities as a function of time and program condition in the Task 4 neuroimaging study sample. Overall, the results replicate the previous findings from the Task 3 in-person and remote samples.

Similar to the remote Task 3 sample, we did not find improvements to trait EI,  $F(1, 67) = .40, p = .53, \eta_p^2 = .006$  or self-reported EI abilities,  $F(1, 67) = 2.23, p = .14, \eta_p^2 = .032$ . Rather, effects appeared to be stronger for measures of *performance-based* emotional abilities. Participants in the EIT program demonstrated greater increases relative to those in the PAT program in their levels of emotional awareness,  $F(1, 67) = 6.39, p = .014, \eta_p^2 = .087$ , knowledge of effective interpersonal affect regulation strategies (IPART: BC),  $F(1, 67) = 8.21, p = .006, \eta_p^2 = .11$ , and tendencies to choose effective ways to regulating the emotions of others (IPART: PC),  $F(1, 67) = 19.27, p < .001, \eta_p^2 = .22$  (see **Figure 58**).

**Task 4 Conclusion:** The findings show that the EIT program was effective at improving emotional intelligence and emotional skills in this smaller sample, providing further replication of the outcomes from Task 3 (the larger in-person and remote studies). Moreover, the findings show that the EIT program was associated with meaningful changes in brain responses to an emotional face perception/decision task. The training was associated with reductions in brain regions involved in conflict monitoring and emotional responsiveness and increases in higher-order prefrontal cortical regions involved in regulating emotional responses. Finally, the data also demonstrate that changes in EI over the training period for the entire sample were meaningfully associated with increases in activation of medial prefrontal brain regions associated with Theory of Mind processes that are critical to understanding the emotional perspective and experience of others. These findings provide further construct validation to the EIT program.

### 3.5 TASK 5: Military Effectiveness: ROTC Cadets

**Overview:** Task 3 and Task 4 provided solid evidence that the EIT program is effective at improving EI and other emotional skills in civilian samples drawn from the general population. The Task 5 study aimed to extend these findings by demonstrating the effectiveness of the training in militarily relevant contexts. Specifically, this study examined whether the EIT program would benefit ROTC cadets as they develop the leadership, teamwork, and military skills necessary to be effective Service members. This task was designed to address *Specific Aim #3: Determine the effectiveness of the EI training program for enhancing military performance and sustaining psychological health during stressful military operations/activities/deployments.*

Our initial plan was to closely follow cadets and collect ecological data (e.g., weekly measures of heart rate variability) as they completed the ROTC Leadership Development and Assessment Course. However, we were unable to obtain the level of access needed to complete the study exactly as proposed, in large part due to the emergence of the COVID-19 pandemic. We accordingly adjusted the study protocol to a standard pre-post training design, similar to the previously described civilian studies. Near the beginning of the semester, participants completed a baseline questionnaire that included measures of EI, emotional skills, interpersonal skills, mental health, resilience, and well-being. They were then randomly assigned to the PAT or EIT conditions, which they were asked to complete over a three-week time period. Near the end of the semester, participants completed a post-training questionnaire with the same measures.

**Sample Description:** Participants were recruited from the three ROTC programs (Air Force, Army, Navy) at the University of Arizona and Arizona State University. This data was collected between Fall 2018 and Spring 2021. A total of  $n = 163$  cadets completed the baseline assessments and were randomly assigned to take the EIT or PAT programs. A total of  $n = 134$  completed their assigned programs and the post-training assessments. **Table 7** provides a summary of the characteristics of this sample.

**Table 7**  
*Characteristics of Participants at Baseline and Post-Training*

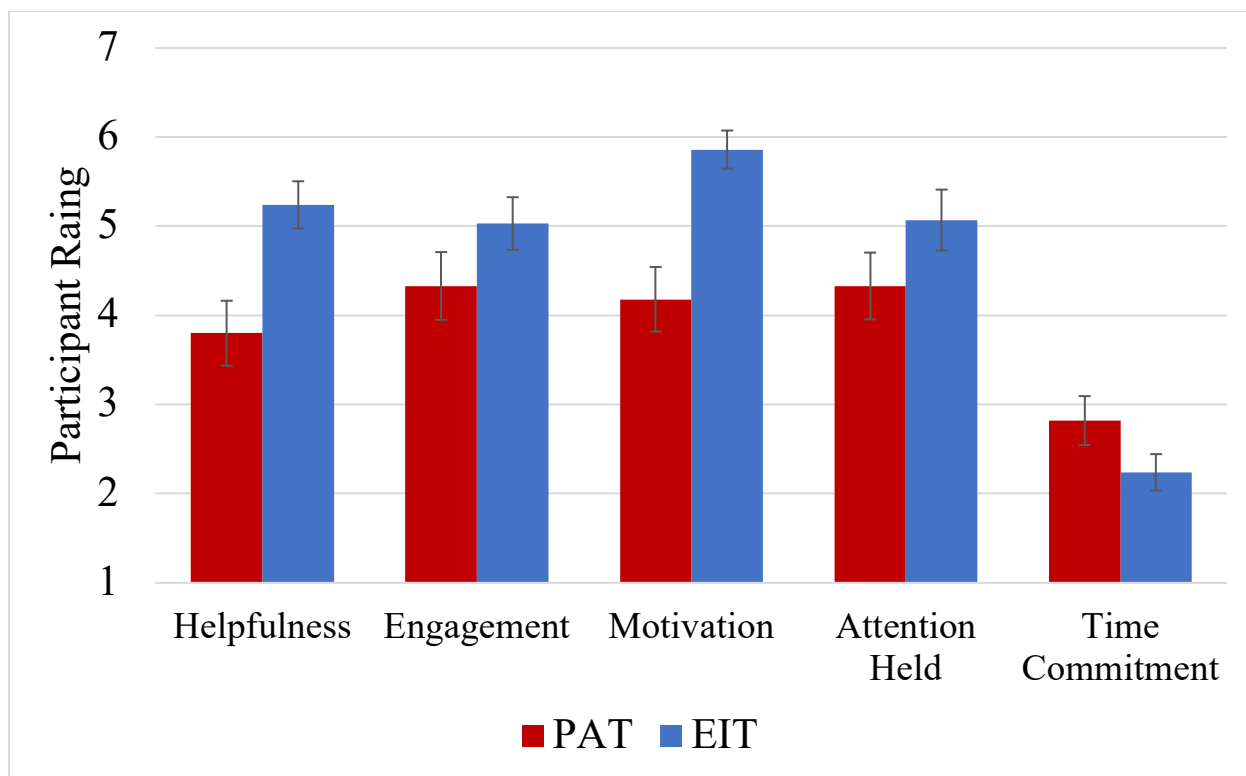
	<b>Baseline <math>n = 163</math></b>	<b>Post-Training <math>n = 134</math></b>
<b>Age</b>	$M = 20.27 (2.27)$	$M = 20.29 (2.37)$
<b>Gender</b>		
Male	65%	64%
Female	35%	36%
<b>Ethnicity</b>		
White	62%	58%
Black or African American	1%	1%
Native American or Alaska Native	1%	1%
Asian	12%	14%
Native Hawaiian or Pacific Islander	2%	2%
Latino or Hispanic	13%	13%
More than one race	7%	8%

**Table 7 (Cont.)***Characteristics of Participants at Baseline and Post-Training*

	<b>Baseline <i>n</i> = 163</b>	<b>Post-Training <i>n</i> = 134</b>
<b>Ethnicity</b>		
Other	1%	1%
Prefer not to answer	1%	1%
<b>ROTC Branch</b>		
Air Force	27%	28%
Army	35%	30%
Navy	39%	43%
<b>Recruitment Site</b>		
University of Arizona	75%	72%
Arizona State University	25%	28%
<b>Semester Participated</b>		
Fall 2018	29%	31%
Spring 2019	11%	10%
Spring 2020	17%	15%
Fall 2020	30%	32%
Spring 2021	16%	13%
<b>Randomization</b>		
EIT	52%	50%
PAT	48%	50%

**Analyses:** To examine the effectiveness of the program, we conducted a series of program (EIT, PAT) x time (baseline, post-training) ANCOVAs. We included age and sex as covariates, as these variables have been shown to correlate with emotional abilities (Fernandez-Berrocal et al., 2012). In addition, about 40% of the sample completed the study before the onset of the COVID-19 pandemic, and the rest completed the study post-COVID. The timing of the completion could possibly affect the outcomes of the data, as research shows that the COVID-19 pandemic has been incredibly stressful and taxing on emotional resources (Persich et al., 2021). We therefore included the semester of participation (pre- vs post-COVID) as an additional covariate.

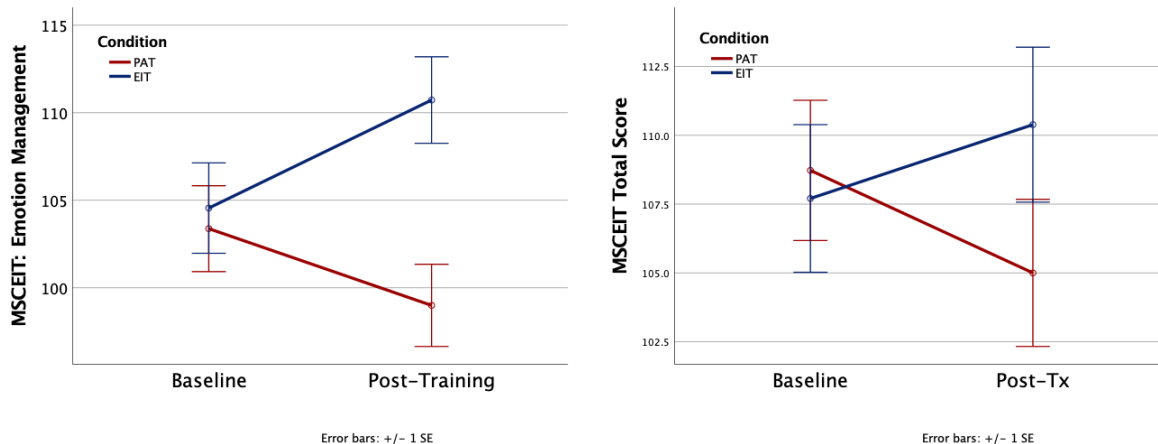
**Program Perceptions:** We continued to track subjective perceptions of the EIT vs the PAT programs. Upon completion of the program, we asked participants to rate how helpful, engaging, motivating, attention holding, and time consuming the program was (1 = not at all; 7 = very). As shown in **Figure 59**, participants in the EIT program tended to have more positive perceptions of the training, with helpfulness, engagement, motivation, and attention all being rated on average above the scale midpoint. Time commitment was also rated on average below the scale midpoint. In addition, those in the EIT program had more positive perceptions of the training when compared to those in the PAT program. EIT participants rated the program as significantly more helpful,  $t(112) = 6.31, p < .001, d = 1.22$ , more engaging,  $t(112) = 2.89, p = .002, d = 1.30$ , and more motivating,  $t(112) = 7.94, p < .001, d = 1.13$ . EIT participants also reported that the program did a better job at holding their attention,  $t(112) = 2.87, p = .005, d = 1.38$ , and that they perceived the program to be less time consuming,  $t(112) = .001, d = .92$ . These are all large effect sizes.



**Figure 59.** Comparisons of program perceptions between the EIT and placebo programs.

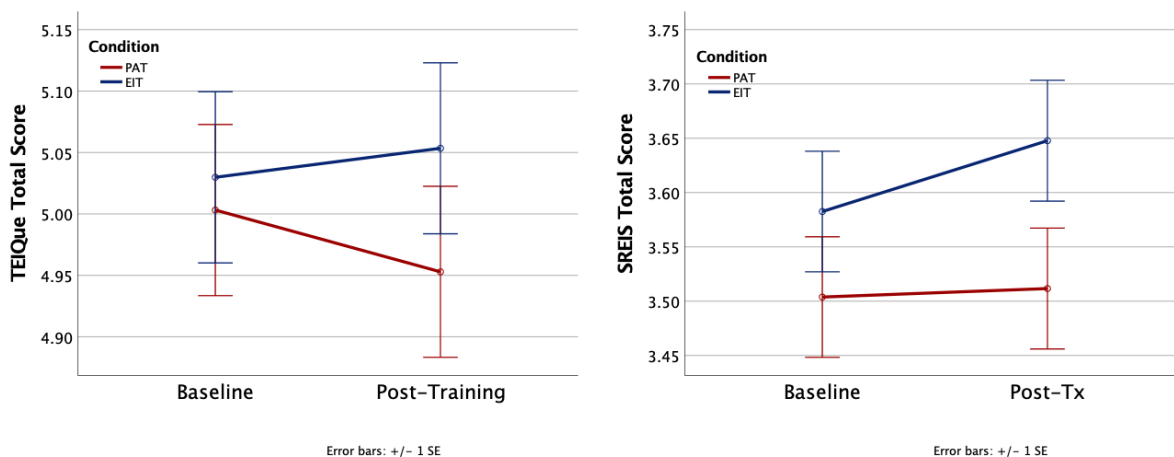
***Hypothesis 1: The optimized EI Training Program will produce significantly greater enhancement of measured EI, resilience, Grit, coping capacity, and emotional wellbeing than a matched Placebo Training Program by the end of LDAC.***

Ability-Based Emotional Intelligence: EI was assessed using measures of ability EI (MSCEIT:(Mayer et al., 2002)), self-reported trait EI (TEIQue: (Petrides, 2009)), self-reported of EI abilities (SREIS: (Brackett et al., 2006)). The MSCEIT was added in the spring of 2020, so only a subset of participants ( $n = 78$ ) have data for this measure. The MSCEIT is considered to be the “gold-standard” for measuring EI abilities, and assesses ability to perceive, use, understand, and manage emotions. The scale also includes a total score that reflects overall EI abilities. Results showed that the EIT program was effective at improving the MSCEIT total score,  $F(1, 74) = 5.16$ ,  $p = .026$ . As shown in **Figure 60**, participants assigned to the EIT program showed a greater improvement to their EI total scores relative to those in the PAT program. In terms of particular EI abilities, the first three MSCEIT branches of perceiving, using, and understanding emotion were not significant,  $ps = .979, .981$ , and  $.781$  respectively. However, the EIT program appeared particularly effective at improving emotion management scores,  $F(1, 74) = 9.89$ ,  $p = .002$ . As shown in **Figure 60**, participants in the EIT program on average gained nearly six points on their MSCEIT management scores, moving from what the MSCEIT manual describes as a “high average” range (100-109) to the “competent” range (110-119). Emotion management skills are especially critical for effective leadership and teamwork, and this finding suggests that the EIT program is beneficial for ROTC cadets.



**Figure 60.** MCSEIT emotion management and MSCEIT total scores as a function of program assignment and time. Participants in the EIT program showed greater increases in EI abilities relative to those in the placebo program.

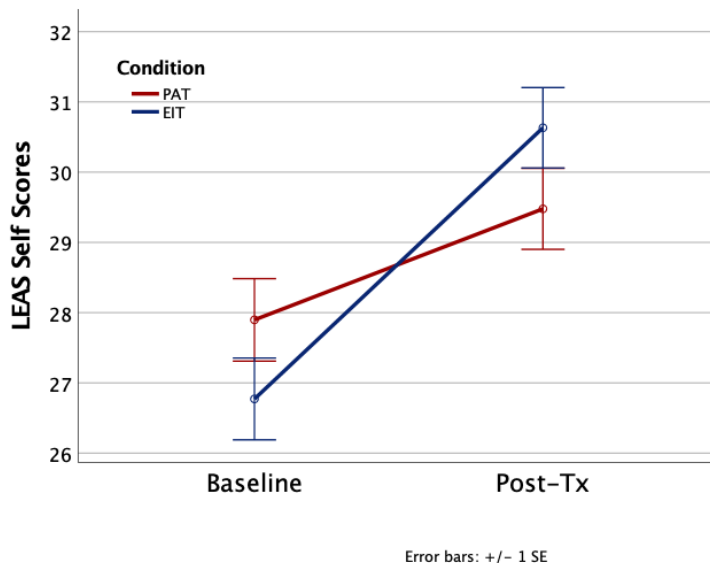
**Self-Reported Emotional Intelligence.** Self-reported EI is thought to capture personality-like aspects of emotional intelligence (i.e., attitudes, cognitions, motivations, and typical behaviors related to EI). We did not find significant improvements in self-reported EI as a function of program assignment for either the TEIQue,  $F(1, 129) = 1.54, p = .217$ , or the SREIS,  $F(1, 129) = .80, p = .374$ ; **Figure 61**). Although we had initially hypothesized that individuals in the EIT program would show significant improvements on these measures, the null results are in line with our finding from Task 3. In task 3, we found that self-reported EI increased immediately following the training but returned to baseline levels over time. This is reasonable, as personality assessment may be sensitive to situational factors (like reporting an increase in EI immediately after taking an EI training program), but personality is likely to remain fairly stable and resistant to change over the long-term (cites). This study was spread out over the course of the semester and the post-training assessment session was done over a month after training, rather than immediately after the training. This longer time period meant that the data most likely did not register the momentary effects of training, and self-reported EI levels had returned to around baseline by the time we assessed it.



**Figure 61.** TEIQue and SREIS total scores as a function of program assignment and time. Scores on these self-reported EI measures did not show significant changes over time.

Emotional Abilities: Beyond the core EI measure, we also assessed a number of other emotional abilities, including emotional awareness, interoceptive awareness, ability to feel emotions, experiential avoidance, and emotion regulation.

*Emotional Awareness.* Emotional awareness describes individual differences in ability to experience emotion in a complex and differentiated manner. Emotional awareness was measured using the Levels of Emotional Awareness Scale (LEAS: (Lane et al., 1990)). There was a marginal *program x time* interaction in LEAS total scores,  $F(1, 128) = 3.78$ ,  $p = .054$ ,  $\eta_p^2 = .03$ . Upon examining the subcomponents of the LEAS, we found that the EIT program significantly improved awareness of one's own emotion relative to the PAT program,  $F(1, 128) = 5.88$ ,  $p = .017$ ,  $\eta_p^2 = .04$ , but not awareness of others' emotion,  $F(1, 128) = 1.29$ ,  $p = .259$ ,  $\eta_p^2 = .01$ . As shown in **Figure 62**, participants in the EIT program showed a richer, more complex, and differentiated level of understanding and experiencing their own emotions relative to those in the PAT program.

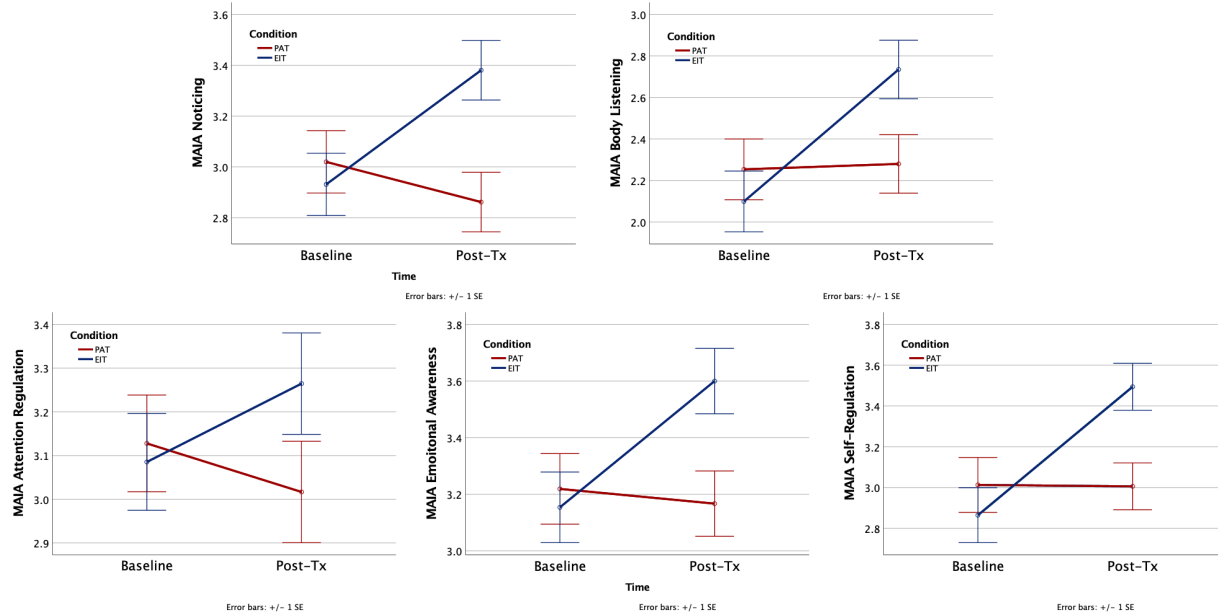


**Figure 62.** Improvements to awareness of one's own emotions as a function of program assignment and time. Both groups achieved higher scores post-training, but the EIT group demonstrated a greater increase

*Interoceptive Awareness.* Interoceptive awareness refers to the ability to identify, understand, and respond to internal signals. Higher levels of interoceptive awareness should enhance emotional abilities, as it helps individuals perceive emotions, facilitates understanding of emotional reactions, and enables the appropriate regulation of emotions. Interoceptive awareness was measured using the Multidimensional Assessment of Interoceptive Awareness (MAIA: (Mehling et al., 2012)). The MAIA assesses eight dimensions of interoceptive awareness, including: 1) noticing sensation, 2) not distracting from sensations, 3) not worrying about sensations, 4) attention regulation, 5) emotional awareness, 6) self-regulation, 7) body listening, and 8) trusting bodily sensations. Overall, we found that the EIT program was highly effective at improving interoceptive awareness, with significant results showing medium to large effect sizes. As shown in **Figure 63**, the EIT program lead to improvements in noticing sensation,  $F(1, 129) = 10.43$ ,  $p = .002$ ,  $\eta_p^2 = .08$ , and body listening,  $F(1, 129) = 11.21$ ,  $p = .001$ ,  $\eta_p^2 = .08$ , suggesting that the EIT program helped cadets become aware of their bodily sensations and actively listen to their bodies for insight. Cadets in the EIT program also showed marginal improvements in their ability to sustain and control their attention to body sensations,  $F(1, 129) = 3.72$ ,  $p = .056$ ,  $\eta_p^2 = .03$ . They also showed significant improvements relative to the PAT group in their emotional awareness,  $F(1, 129) = 8.55$ ,  $p = .004$ ,  $\eta_p^2 = .06$ , and self-regulation ability,  $F(1, 129) = 14.05$ ,  $p < .001$ ,  $\eta_p^2 = .10$ , suggesting that cadets were better able to understand physiological manifestations of emotion and regulate their emotion by paying attention to these sensations. The program x time interaction was not significant for the

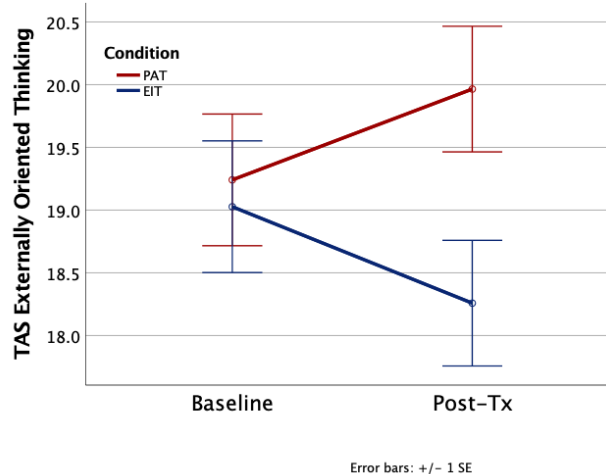


MAIA dimensions of not distracting,  $F(1, 129) = .18, p = .669, \eta_p^2 = .00$ , not worrying about physical discomfort,  $F(1, 129) = .24, p = .624, \eta_p^2 = .00$ , or trusting bodily sensations,  $F(1, 129) = .19, p = .663, \eta_p^2 = .00$ .



**Figure 63.** Changes in interoceptive awareness as a function of program assignment and time. ROTC cadets in the EIT program showed strong improvements in their ability to notice bodily sensations, listen to their bodies, control their attention to their body, understand emotional reactions, and self-regulate emotions.

*Feeling Emotion.* Alexithymia is characterized by a difficulty in the cognitive processing of emotions. Alexithymia was assessed using the Toronto Alexithymia Scale (TAS: (Bagby et al., 1994)), which provides an overall score as well as three sub-components: difficulty identifying feelings, difficulty describing feelings, and a tendency for externally oriented thinking. As shown in **Figure 64**, participants in the EIT program showed a significant reduction in their externally oriented thinking tendencies,  $F(1, 129) = 7.13, p = .009, \eta_p^2 = .05$ . The externally oriented thinking sub-component of the TAS is linked to difficulties in recognizing external cues of emotion and is implicated in deficits in facial recognition of emotions, empathy, and theory of mind (Demers & Koven, 2015; Lyvers et al., 2017). These areas were



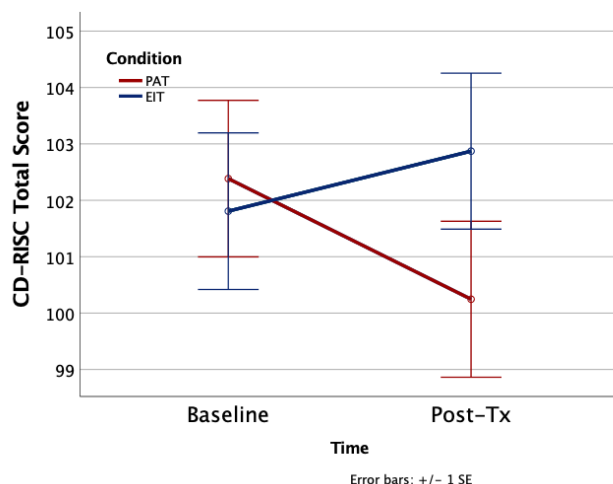
**Figure 64.** Improvements to tendencies towards externally oriented thinking.

explicitly targeted in the EIT program and are critical skills for effective leaders and team members to have.

*Experiential Avoidance.* Experiential avoidance is the tendency to avoid uncomfortable thoughts and feelings, even though doing so may have undesirable long-term consequences. Experiential avoidance was assessed using the Multidimensional Experiential Avoidance Questionnaire (MEAQ: (Gamez et al., 2011)). The measure provides an overall score, as well as scores for six dimensions: behavioral avoidance, ignoring or suppressing distress, procrastinating, distress aversion, repressing or denying distress, and enduring distress. Cadets in the EIT program showed a marginal reduction in their distress aversion,  $F(1, 129) = 3.62, p = .059, \eta_p^2 = .03$ , and repression and denial of distress,  $F(1, 129) = 3.83, p = .053, \eta_p^2 = .03$ . However, the other four dimensions were non-significant,  $ps = .431-.974$ , nor was the MEAQ total score,  $F(1, 129) = 2.60, p = .110, \eta_p^2 = .02$ .

*Emotion Regulation.* Emotion regulation is an important skill for adaptively navigating stressful and emotionally demanding circumstances. We assessed difficulty regulating emotions using the Difficulties in Emotion Regulation Scale (DERS). We also assessed the tendency to use two specific emotion regulation strategies, cognitive reappraisal and emotion suppression, using the Emotion Regulation Questionnaire (ERQ). We surprisingly did not find support for the hypothesis that EIT would improve emotion regulation abilities. There was no difference between groups on the DERS total score,  $F(1, 129) = .06, p = .803, \eta_p^2 = .00$ , nor were there any significant differences for any of the DERS subscales,  $ps = .128-.870$ . Similar null results were found for ERQ cognitive reappraisal,  $F(1, 129) = .15, p = .697, \eta_p^2 = .00$  and emotional suppression,  $F(1, 129) = .35, p = .556, \eta_p^2 = .00$ . Future work will need to focus on enhancing these capacities.

**Resilience:** We had hypothesized that the EIT program would increase resilience in ROTC cadets and help them thrive in the face of adversity. To assess resilience, we administered the Connor-Davidson Resilience Scale (CD-RISC: (Connor & Davidson, 2003)). This scale provides an



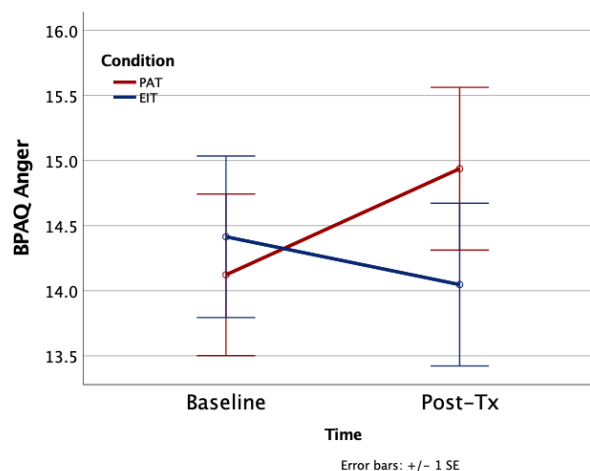
**Figure 65.** Improvements in resilience as a function of program assignment and time. Participants in the EIT program showed an increase in resilience scores whereas the PAT group showed a decrease in scores.

overall indication of resilience as well as five subcomponents: personal competence, tolerance of negative affect, positive acceptance of change, personal control, and spiritual influences. As shown in **Figure 65**, participants in the EIT program tended to show an increase in their CD-RISC scores, whereas participants in the PAT program tended to decrease,  $F(1, 129) = 3.98, p = .048, \eta_p^2 = .03$ . A closer examination of the CD-RISC subscales revealed the participants in the EIT program significantly improved in their feelings of personal control relative to the PAT group,  $F(1, 129) = 4.03, p = .047, \eta_p^2 = .03$ . There was also a marginal effect for tolerance of negative affect,  $F(1, 129) = 3.47, p = .065$ . There were no significant

differences in the other subscales,  $ps = .122-.658$ .

**Mental Health and Well-Being:** We hypothesized that the EIT program would significantly improve the mental health and well-being of ROTC cadets. Participants completed a series of mental health and well-being questionnaires that included measures of depression (Beck Depression Inventory (BDI-II: (Beck et al., 1996))), anxiety (State-Trait Anxiety Inventory (STAI: (Spielberger et al., 1983))), flourishing (Flourishing Scale: (Diener et al., 2010)), satisfaction with life (Satisfaction with Life Scale (SWLS: (Diener et al., 1985))), and Affect (Positive and Negative Affect Schedule (PANAS: (Watson et al., 1988))). We did not find support for this hypothesis. There were no significant *program x time* interaction for depression,  $F(1, 129) = .08, p = .779, \eta_p^2 = .00$ , state anxiety,  $F(1, 129) = .61, p = .436, \eta_p^2 = .01$ , or trait anxiety,  $F(1, 129) = .92, p = .338, \eta_p^2 = .01$ . Similarly, we found null results for flourishing,  $F(1, 129) = .48, p = .489, \eta_p^2 = .00$ , satisfaction with life,  $F(1, 129) = .09, p = .763, \eta_p^2 = .00$ , positive affect,  $F(1, 129) = 1.12, p = .291, \eta_p^2 = .01$ , and negative affect,  $F(1, 129) = .59, p = .443, \eta_p^2 = .01$ .

**Interpersonal Aggression:** Interpersonal aggression has been a growing concern in the military community. Although aggression is useful in combat situations, it can cause problems within romantic relationships, friendships, and teams. We assessed interpersonal aggression using the Buss-Perry Aggression Questionnaire (BPAQ: (Buss & Perry, 1992)). This questionnaire provides an overall indication of aggression, as well as tendencies towards physical aggression, verbal aggression, anger, and hostility. We found the EIT program tended to decrease levels of anger relative to the placebo training,  $F(1, 129) = 4.05, p = .046, \eta_p^2 = .03$ . As shown in **Figure 66**, participants in the EIT program tended to decrease in their levels of anger whereas those in the placebo program tended to increase. There was also a marginal effect of the program on changes in hostility,  $F(1, 129) = 3.65, p = .058, \eta_p^2 = .03$ , and the BPAQ total score,  $F(1, 129) = 2.96, p = .088, \eta_p^2 = .02$ . There was no significant interaction for physical or verbal aggression,  $ps = .982$  and  $.582$  respectively.



**Figure 66.** Improvements in anger as a function of program assignment and time. Participants in the EIT program showed a decrease in anger whereas the PAT group showed an increase.

**Hypothesis 2: The optimized EI Training Program will yield significantly lower weekly PSS scores and increase HRV (mean and slope) during the course of LDAC than the matched Placebo Training Program.**

Due to COVID restrictions, we were unable to collect weekly perceived stress and HRV data or assess cadets during the LDAC course. Instead, we collected global PSS scores (Cohen et al., 1983) at baseline and post-training. However, there was no significant time x program condition interaction,  $F(1, 129) = .45, p = .506$ , suggesting that the EIT program did not significantly reduce

global self-reported stress. It is still uncertain of how the EIT program would impact ecological and objective assessments of stress, however. Future research will need to revisit this question once COVID restrictions are lifted.

***Hypothesis 3: Cadets who receive the optimized EI Training Program will attain higher performance ratings and course scores than those receiving the Placebo Training Program.***

Due to setbacks that emerged from the COVID-19 pandemic restrictions, we were unable to obtain performance ratings, leadership rankings, and academic records directly from ROTC leadership. We instead used peer ratings and relied on participants to send us their unofficial academic transcripts to access performance. Due to the pandemic restrictions, access to the cadets was limited to online contacts and many cadets failed to provide needed information. Nonetheless, we obtained peer evaluation at both timepoints from 85 participants. These participants ranked each member of their cohort in terms of overall quality, self-confidence, frustration tolerance, and conflict management skills. We were also able to obtain transcripts from  $n = 48$  participants and these transcripts allowed us to record data related to overall GPAs, semester GPA, academic honors, and performance in ROTC classes.

Peer Data: Participants ranked both themselves and the rest of their cohort on various attributes. We created two separate variables – one indicating how the cadets ranked themselves and the other indicating how the cadets were ranked by their peers. We then converted the ranking to a percentile to standardize the scoring, as the different classes were often different sizes. To assess reliability of the peer ratings, we computed an intraclass correlation coefficient for each group with more than 3 raters. Ratings tended to demonstrate fairly low ICCs, indicating poor reliability of the rankings. The ICCs did vary greatly between groups, with some groups demonstrating high levels of agreement on the rankings, some demonstrating no agreement, and others ranking each other in complete opposite orders. ICCs for each rating can be found in table 8. Levels of agreement appeared to systematically vary as a function of class size (negative correlation) and whether they participated before or after the onset of the COVID-19 pandemic (lower levels of agreement among post-pandemic cohorts). Due to the restrictions imposed during the pandemic, many cadets had to remain at home and engage in their courses online only for up to a year. Consequently, some cohorts simply may not have known their peers well enough to make knowledgeable ratings of their qualities. Perhaps unsurprisingly, given the poor reliability of the data, there were no significant changes in peer rankings as a function of program, even after controlling for agreement levels,  $ps = .147-.956$ . There were also no significant *time x program* interactions on any of the self-ranked variables,  $ps = .345-.687$ . This would still be an important area for future focus once the pandemic restrictions have been lifted and cadets are able to fully participate in-person once again.

**Table 8.**  
*Intraclass correlation coefficients*

	M (SD)	Minimum	Maximum
Overall Quality	.63(.26)	.13	.92
Self-Confidence	.43 (.48)	-.48	.84
Frustration Tolerance	.31 (.55)	-.79	.78
Conflict Management	.42 (.53)	-.89	.96

Academic Performance: We analyzed transcript data using multilevel modeling (MLM) with semester-level data (Level 1) nested within each participant (Level 2). To quantify the intervention, we created a dummy time variable in which all semesters prior to training were coded as 0 and all semesters after training were coded as 1. We then ran a program condition (EIT, PAT) x time (Pre-Tx, Post-Tx) MLM to determine whether there was an average increase in academic performance following training and whether this increase would vary as a function of the training program.

Overall, we did not find support for this hypothesis. In terms of semester GPA, there were significant effects of program condition,  $t = -2.05, p = .045$ , and time,  $t = 2.15, p = .033$ , such that individuals in the PAT condition tended to have higher GPAs and both groups tended to improve their GPAs following training. However, there was no time x program interaction,  $t = -.55, p = .586$ . A similar effect was found for the academic honors, in which individuals in the PAT group received a greater number of academic honors (e.g., dean's list),  $t = -2.33, p = .023$ , but this main effect was not qualified by a group x time interaction,  $t = 0.45, p = .652$ . With regard to grades in ROTC, there was too little variability in grades to test our hypotheses, as most participants received similar grades. In general, we are cautious to interpret these null effects as an indication of the EIT program's effect on academic performance. The reliance on participants to provide their transcript may have introduced bias to the sample. We will therefore need to return to this question when COVID-19 restrictions have lifted and use a different study design to collect thorough, comprehensive academic and performance records for all participants.

**Conclusion:** Task 5 further demonstrated the effectiveness of the EI training in military relevant contexts. ROTC cadets who took the EIT program showed significant improvements to key EI abilities. They also showed improvements to a number of other relevant emotional skills such as emotional awareness, interoceptive awareness, and feeling emotions, as well as a decline in levels of interpersonal aggression. Finally, cadets in the EIT program showed increases in resilience compared to the placebo group, and increasing resilience is one of the ultimate goals of this program of research. Overall, task 5 suggests that the EIT program enhanced emotional competencies of ROTCs cadets.

### 3.6 TASK 6: Active-Duty Military Effectiveness

**Overview:** The ultimate test of the effectiveness of the EIT program was to evaluate the effectiveness of the EIT program for sustaining or improving measures of mental health, emotional intelligence, and resilience in active-duty military personnel. This task was designed to address *Specific Aim #3: Determine the effectiveness of the EI training program for enhancing military performance and sustaining psychological health during stressful military operations/activities/deployments.*

Our initial plan was to directly recruit active-duty military Service members (SMs) from military installations and collect data as SMs went through a stressful period of their lives (either during field training or pre-post deployment). However, we were unable to obtain the level of access needed to complete the study exactly as proposed due to the COVID-19 pandemic. Out of necessity, we adjusted the study protocol to a standard pre-post training design, similar to the previously described approach in Tasks 3-5 and initiated a nationwide advertising campaign to carry out a completely virtual data collection during the pandemic period. Using our online assessment portal, participants completed a baseline questionnaire that included measures of mental health and well-being, interpersonal relationships, EI, and resilience. They were then randomly assigned to the PAT or EIT conditions, which they were asked to complete over a three-week time period. To simulate the original study design, the baseline and post-training assessments were spread out over a longer period, with a 35-day waiting period between the end of training and the post-training assessment session. Once this waiting period had elapsed, participants



**Figure 67.** Diagram of the study design. Participants completed their baseline assessments and were then randomly assigned to either the EI or placebo training program. After completing the training, participants waited five weeks, after which they did a post-training assessment session.

completed a post-training questionnaire with the same measures as the baseline questionnaire. A visual description of the study design can be found in **Figure 67**.

**Sample Description:** Due to the COVID-19 pandemic restrictions, we were unable to directly recruit SMs from military installations as initially planned. To overcome this setback, we opened up recruitment to active-duty personnel across the country via our online portal. This allowed us to gather a more diverse sample that includes SMs from multiple branches and geographic regions. We used a multifaceted approach to recruiting Task 6 Service members, which involved a combination of online advertisements through social media sites such as Facebook and Instagram, as well as through MWR and advertising departments directly connected to military installations. In addition to this, we have utilized radio advertisements, military-related newspaper and social

media resources, and word-of-mouth to recruit subjects. A total of 278 active-duty participants completed the baseline assessments and were randomly assigned to either the EIT or PAT programs. A total of  $n = 209$  active military personnel completed their assigned programs and the post-training assessments. **Table 9** provides a summary of the characteristics of this sample.

**Table 9**

*Characteristics of Participants at Baseline and Post-Training*

	<b>Baseline <math>n = 273</math></b>	<b>Post-Training <math>n = 209</math></b>
<b>Age</b>	$M = 29.59 (5.92)$	$M = 29.94 (5.92)$
<b>Gender</b>		
Male	72%	72%
Female	28%	28%
<b>Ethnicity</b>		
White	59%	61%
Black or African American	7%	7%
Native American or Alaska Native	1%	<1%
Asian	4%	5%
Native Hawaiian or Pacific Islander	1%	1%
Latino or Hispanic	19%	16%
More than one race	7%	8%
Other	<1%	<1%
Prefer not to Answer	1%	1%
<b>Military Branch</b>		
Air Force	35%	34%
Army	46%	48%
Coast Guard	1%	<1%
Marine Corps	5%	5%
Navy	12%	11%
Space Force	1%	<1%
<b>Military Rank</b>		
Enlisted	77%	74%
Officer	23%	26%
<b>Military Experience</b>		
Years Active	$M = 8.35 (5.52)$	$M = 8.67 (5.55)$
Deployment	63%	65%
Combat Experience	31%	33%
<b>Program Assignment</b>		
EIT	50%	50%
PAT	55%	45%

**Analyses:** While cleaning the data, we noticed that there were a large number of participants (~20) with obviously questionable data. This appears to be a weakness induced by the unsupervised online nature of the data collection. Instances that triggered concerns included impossibly fast completion times (e.g., completing a 344-item questionnaire in under 5 minutes) and patterned responding (e.g., choosing “4” for every response). To ensure the quality of the data, we decided



to utilize several imbedded validity indices in some of the standardized measures, such as the Personality Assessment Inventory (Morey, 1991), to flag invalid responders. This inventory contains a set of four indices that help clinicians determine whether a profile is invalid due to non-conscientious responding or impression management. These four indices include: 1) an inconsistency (ICN) index that measures the degree to which participants answer similar questions in different ways, 2) an infrequency (INF) index that measures a tendency to agree with bizarre and unusual statements, 3) a negative impression management (NIM) index that measures a tendency for respondents to describe themselves in overly negative ways, and 4) a positive impression management (PIM) index that measures a tendency for respondents to describe themselves in an overly positive way. Response profiles are deemed invalid if respondents score above an established cutoff that previous research had shown to discriminate between valid profiles and faked/random/inattentive profiles (Clark et al., 2003; Rogers et al., 1996).

This procedure was able to capture all participants who had been flagged by study staff as having potentially bad data, and so we decided to listwise exclude all participants with an invalid PAI profile. A total of  $n = 57$  participants had invalid PAI profiles. **Table 10** describes the PAI cutoff scores, and the number of participants excluded due to each index. Note that the numbers in **Table 10** do not sum to 57 because most participants who were excluded exceeded the cutoff scores on multiple indices. We are not sure why this issue with invalid data presented itself in this active-duty military sample, when we did not observe similar issues in the previous datasets with cadets or the general population. Future studies testing the EIT program with active-duty military personnel will need to consider ways to increase data quality in military samples.

**Table 10**

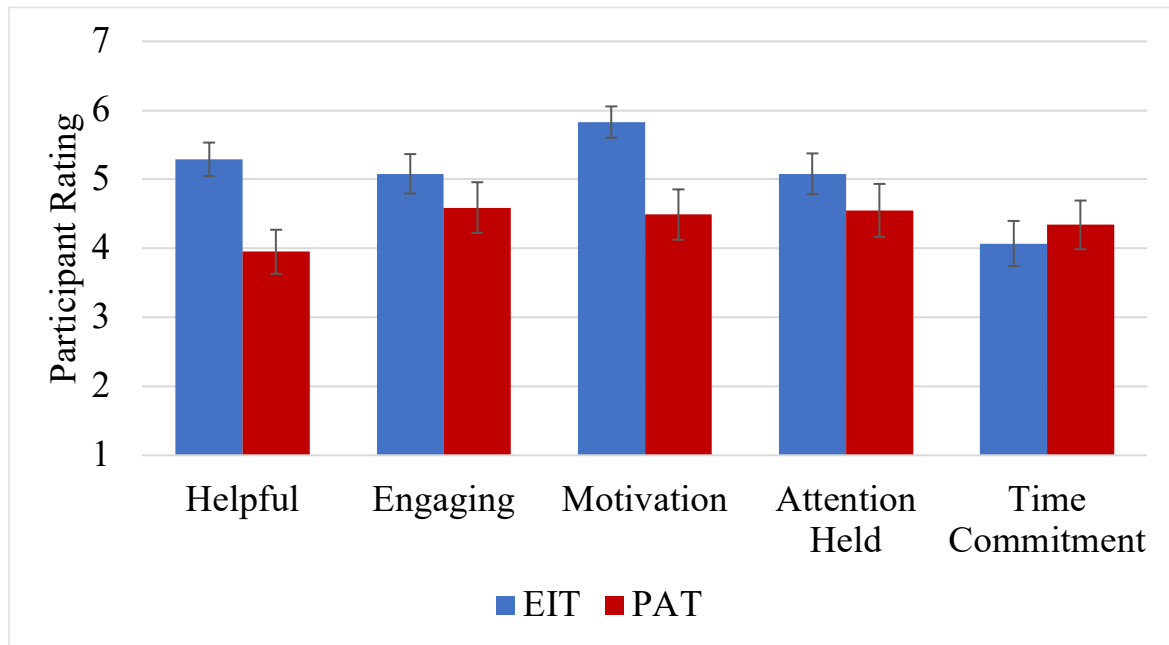
*PAI Validity Index Cutoffs and Number of Participants Excluded*

	<b>Cutoff</b>	<b>Baseline Excluded</b>	<b>Post-Tx Excluded</b>
ICN	>73T	13	10
INF	>75T	12	14
NIM	>90T	3	4
PIM	>68T	12	17
<b>Total</b>		<b>40</b>	<b>45</b>

To examine the effectiveness of the program, we conducted a series of program (EIT, PAT) x time (baseline, post-training) ANCOVAs. We included age and sex as covariates, as these variables have been shown to correlate with emotional abilities.

**Program Perceptions:** As in the prior tasks, we continued to track subjective perceptions of the EIT vs the PAT programs. Upon completion of the program, we asked participants to rate how helpful, engaging, motivating, attention holding, and time consuming the program was (1 = not at all; 7 = very). As shown in **Figure 68**, participants in the EIT program tended to have more positive perceptions of the training, with helpfulness, engagement, motivation, and attention all being rated on average above the scale midpoint. In addition, those in the EIT program had more positive perceptions of the training when compared to those in the PAT program. EIT participants rated the program as significantly more helpful,  $t(158) = 6.65, p < .001$ , more engaging,  $t(158) = 2.09, p = .038$ , and more motivating,  $t(158) = 6.29, p < .001$ . EIT participants also reported that the

program did a better job at holding their attention,  $t(158) = 2.19, p = .030$ , but they did not differ in their perceptions of how time consuming the programs were,  $t(158) = 1.11, p = .268$ .

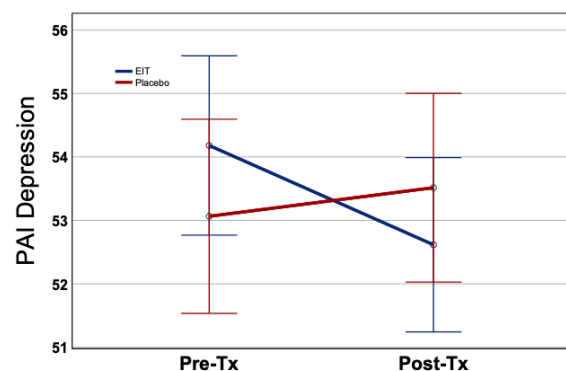


**Figure 68.** Comparisons of program perceptions between the EIT and placebo programs.

**Hypothesis 1.** *The optimized EI Training Program will produce significantly greater sustainment of mental health (PTSD symptoms; depression; distress; psychopathology symptoms) and enhancement of EI scores, resilience scores, and Grit scores than a matched Placebo Training*

**Mental Health.** We hypothesized that the EIT program would help sustain or improve the mental health of active-duty military personnel. Participants completed a series of mental health questionnaires. The main assessment was the Personality Assessment Inventory, a comprehensive 344-item inventory that assesses personality and psychopathology (Morey, 1991, 2007). To supplement this inventory, we also administered the Beck Depression Inventory (BDI-II: (Beck et al., 1996)), State-Trait Anxiety Inventory (STAI (Spielberger et al., 1983)), the PTSD checklist for the DSM-5 (PCL5: (Blevins et al., 2015)), and the Patient Stress Questionnaire (PSQ: (Levenstein et al., 1993)).

**Depression:** To assess changes in depression, we used the PAI depression scale, BDI-II, and PSQ depression scale. Results showed that there was a marginal time x program condition interaction for the PAI depression scale, such that individuals in the EIT condition tended to have lower depression scores following training,  $F(1, 152) = 3.72, p = .072, \eta_p^2 = .02$  (See **Figure 69**). Further examination of the PAI depression



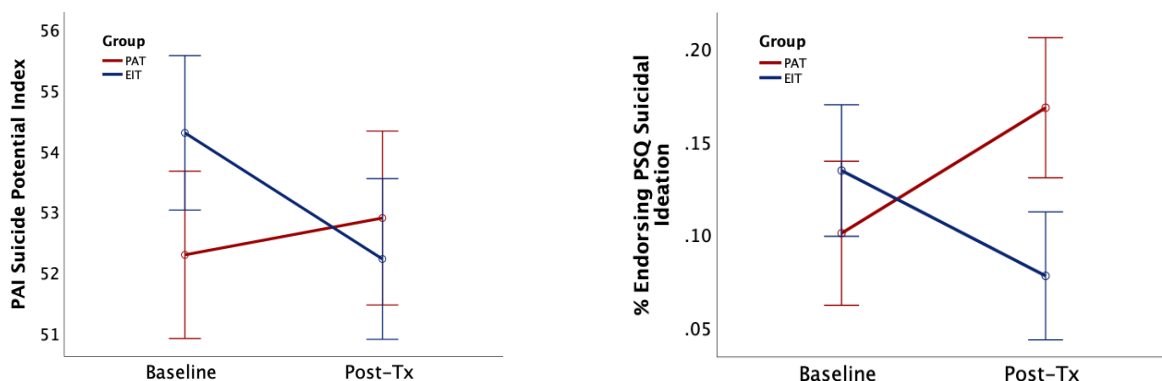
**Figure 69.** Changes in PAI depression scores as a function of time and program assignment.

subscales found no significant time x program condition effects for the cognitive ( $p = .124$ ), affective ( $p = .193$ ), of physiological ( $p = .390$ ) aspects of depression. Null effects were also found for the BDI-II,  $F(1, 156) = .19$ ,  $p = .664$ ,  $\eta_p^2 = .00$ , and PSQ depression scale,  $F(1, 156) = .02$ ,  $p = .894$ ,  $\eta_p^2 = .00$ .

*Suicidality:* Reducing suicide has become a major focus of the military due to the troubling increases in suicide rates in military personnel over the past few years. The EIT program targets many of the emotional, social, and cognitive processes thought to underlie suicidal ideation. For instance, the program aims to develop emotion regulation skills (Wagner & Zimmerman, 2006), improve the quality of interpersonal relationships (Van Orden et al., 2010), and educate participants about cognitive biases that may leave a person vulnerable to suicidal ideation and other forms of psychopathology (Joorman & Vanderlind, 2014; Miranda et al., 2013). Previous results (see Task 3) suggested that the EIT program was effective in reducing suicidal ideation in a civilian sample, and we therefore investigated whether the EIT program would also be beneficial in reducing suicidal tendencies in active-duty military personnel.

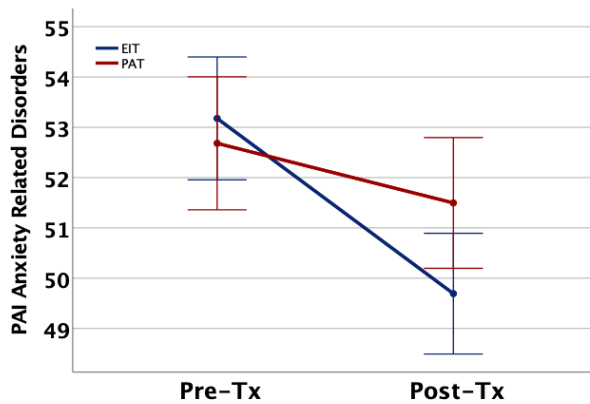
To assess changes in suicidality, we used the PAI and the PSQ-PHQ9. The PAI contains two relevant scales: a suicidal ideation scale, which indicates whether a person is thinking about suicide, and a suicide potential index, which combines common indicators associated with completed suicide (e.g., affective distress, alcohol and drug abuse, social withdraw, impulsivity, etc.) (Sinclair et al., 2012). The PSQ-PHQ9 contains a single item asking about whether a person had thoughts they would be better off dead or hurting themselves in some way.

These analyses supported the hypothesis that the EIT program could be beneficial in reducing suicidality in military personnel. There was a significant time x group interaction for the PAI suicide potential index,  $F(1, 154) = 4.56$ ,  $p = .034$ . As shown in **Figure 70**, participants assigned to the EIT program showed a decline in their suicide potential index scores relative to participants in the PAT group. There was no significant difference in the PAI suicidal ideation scale,  $F(1, 152) = 1.45$ ,  $p = .230$ . However, there was a significant improvement in PHQ9 suicidal ideation,  $F(1, 156) = 5.26$ ,  $p = .023$ . As shown in **Figure 70**, the percentage of individuals endorsing the suicidal ideation question decreased in the EIT group, whereas the percentage increased for the PAT group. These results are quite promising for the usefulness of the EIT program in addressing trouble rates of suicide in active-duty military personnel.



**Figure 70.** Changes in PAI suicide potential index scores and percent endorsing the suicidal ideation item on the PSQ-PHQ9 as a function of time and program assignment.

**Anxiety:** To assess changes in anxiety, we used the PAI anxiety scale which measures general anxiety, the PAI anxiety-related disorders scale which measures anxiety triggered by certain contexts, the STAI, and the PSQ anxiety scale. We found no significant *time x program* interactions for the general anxiety PAI scale,  $F(1, 152) = .73$ ,  $p = .395$ ,  $\eta_p^2 = .01$ , as participants in both conditions showed improvements in their scores. However, there was a significant interaction for anxiety related disorders,  $F(1, 152) = 4.55$ ,  $p = .035$ ,  $\eta_p^2 = .03$  (see **Figure 71**). Closer examination of the anxiety related

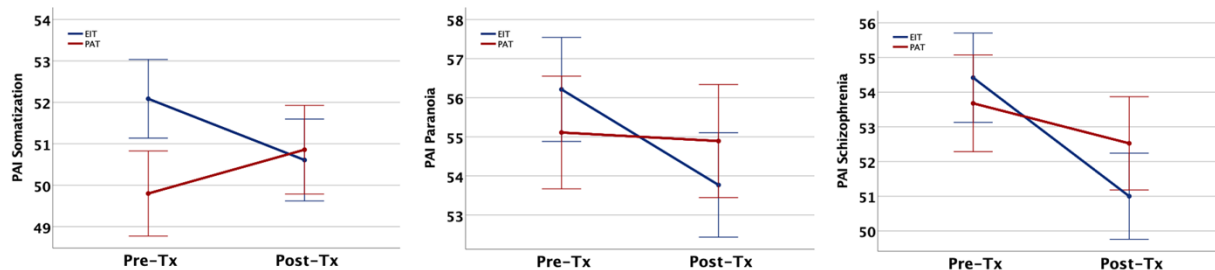


**Figure 71.** Changes in PAI anxiety related disorders scores as a function of time and program assignment.

disorders subscales revealed that the effect was present for the phobias subscale,  $F(1, 152) = 5.50$ ,  $p = .020$ ,  $\eta_p^2 = .04$ , but not OCD,  $p = .395$  or PTSD,  $p = .431$ . There were no significant *time x program* interactions for state anxiety,  $F(1, 156) = .02$ ,  $p = .903$ ,  $\eta_p^2 = .00$ , trait anxiety,  $F(1, 156) = .28$ ,  $p = .597$ ,  $\eta_p^2 = .00$ , or PSQ anxiety,  $F(1, 156) = .56$ ,  $p = .457$ ,  $\eta_p^2 = .00$ .

**PSTD:** Post-traumatic stress disorder is another major problem faced by active-duty military personnel and veterans. We had hypothesized that the EIT program would help improve PTSD symptoms, but we did not find support for this hypothesis. There were no significant *time x program* interaction for PTSD symptoms measures by the PCL5,  $F(1, 65) = .72$ ,  $p = .398$ ,  $\eta_p^2 = .01$ , or the PSQ PTSD scale,  $F(1, 156) = .42$ ,  $p = .517$ ,  $\eta_p^2 = .00$ .

**Other Psychopathology Symptoms:** The PAI assesses a number of psychopathological symptoms, including some that we did not have specific hypotheses as to whether EI training would affect such symptoms. We conducted exploratory analyses looking at the PAI total scores for each area and examined subscales only if an interaction was marginal or significant. We found a number of *time x program* interaction effects (see **Figure 72**). Relative to those in the placebo program, individuals in the EIT program showed a greater decline in somatic complaints post-training,  $F(1, 152) = 8.95$ ,  $p = .003$ ,  $\eta_p^2 = .06$ . This was particularly pronounced for the somatic health concerns subscale,  $F(1, 152) = 13.25$ ,  $p < .001$ ,  $\eta_p^2 = .08$ . Participants in the EIT program also showed marginal improvements on PAI paranoia scores,  $F(1, 152) = 3.79$ ,  $p = .053$ ,  $\eta_p^2 = .02$ , including marginal improvements on the paranoia subscales reflecting feelings of persecution,  $F(1,$



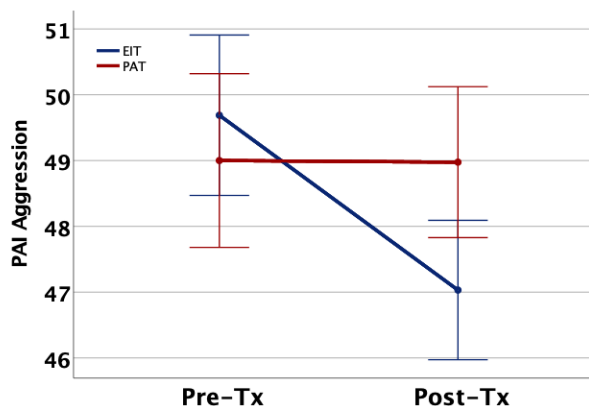
**Figure 72.** Changes in PAI scores for somatic complaints (left), paranoia (middle) and schizophrenia (right) as a function of program condition and time.

152) = 3.74,  $p = .055$ ,  $\eta_p^2 = .02$ , and resentment,  $F(1, 152) = 3.58$ ,  $p = .060$ ,  $\eta_p^2 = .02$ . Participants in the EIT program showed a significant reduction in PAI schizophrenia scores related to those in the PAT program,  $F(1, 152) = 4.44$ ,  $p = .037$ ,  $\eta_p^2 = .03$ , particularly on the thought disorder component of the schizophrenia score,  $F(1, 152) = 4.46$ ,  $p = .037$ ,  $\eta_p^2 = .03$ . There were no significant differences in PAI scores for mania, borderline personality disorder, alcohol problems, drug problems, or stress,  $ps = .198-.704$ .

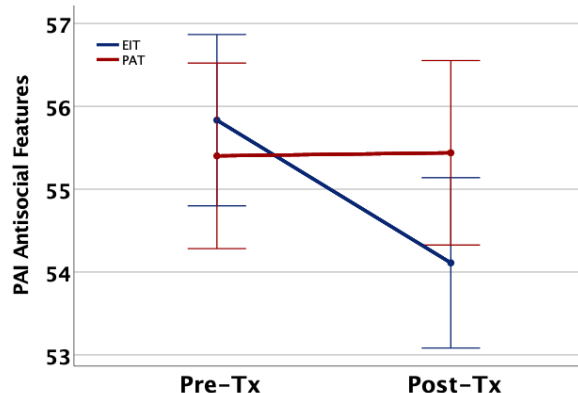
**Interpersonal Difficulties:** Aggressive and violent behavior has been another area of concern for the military, especially with regards to intimate partner violence and sexual harassment. The EIT program contains lessons that may help reduce instances of aggression, including lessons on how to recognize emotions and how to regulate emotions. The EIT program also contains a social skills component that teaches participants how to effectively interact with others. These social skills, such as communication, empathy, assertiveness, and interpersonal affect regulation, should help reduce interpersonal difficulties and improve the quality of relationships (Farmer & Chapman, 2016).

**Aggression:** To assess aggression, we administered the PAI, specifically focusing on the PAI aggression scale. The PAI aggression scale assesses attitudes and behaviors relevant to aggression, anger, and hostility. This scale can also be broken down into three subscales measuring aggressive attitude, verbal aggression, and physical aggression. Results indicated that the EIT program was effective at reducing aggression. There was a significant time x group interaction for the overall PAI aggression scale,  $F(1, 152) = 7.39$ ,  $p = .007$ ,  $\eta_p^2 = .05$ , with participants assigned to the EIT condition showing a greater decrease in aggression scores relative to those assigned to the PAT condition (Figure 73). This interaction was also significant for the aggressive attitudes subscale,  $F(1, 152) = 4.81$ ,  $p = .030$ ,  $\eta_p^2 = .03$ , and marginally significant for the verbal aggression subscale,  $F(1, 152) = 3.72$ ,  $p = .056$ ,  $\eta_p^2 = .02$ .

**Antisocial Features:** To assess antisocial features, we administered the PAI, specifically focusing on the PAI antisocial scale. The PAI antisocial scale assesses impulsivity, hostility, and a history of antisocial acts. This scale can also be broken down into three subscales measuring antisocial behaviors, egocentricity, and stimulus seeking. There was a marginal time x program interaction, such that participants in the EIT program had lower



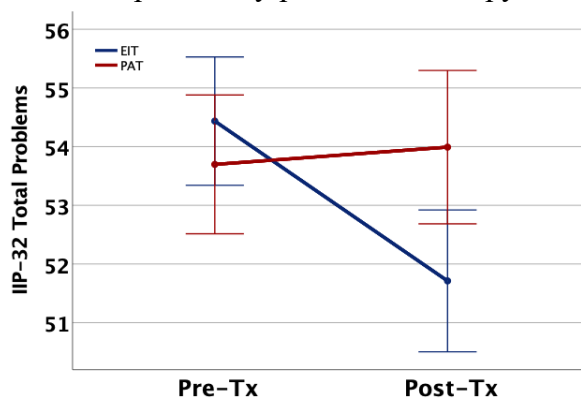
**Figure 73.** Changes in PAI aggression scores as a function of time and program assignment.



**Figure 74.** Changes in PAI antisocial features as a function of time and program assignment.

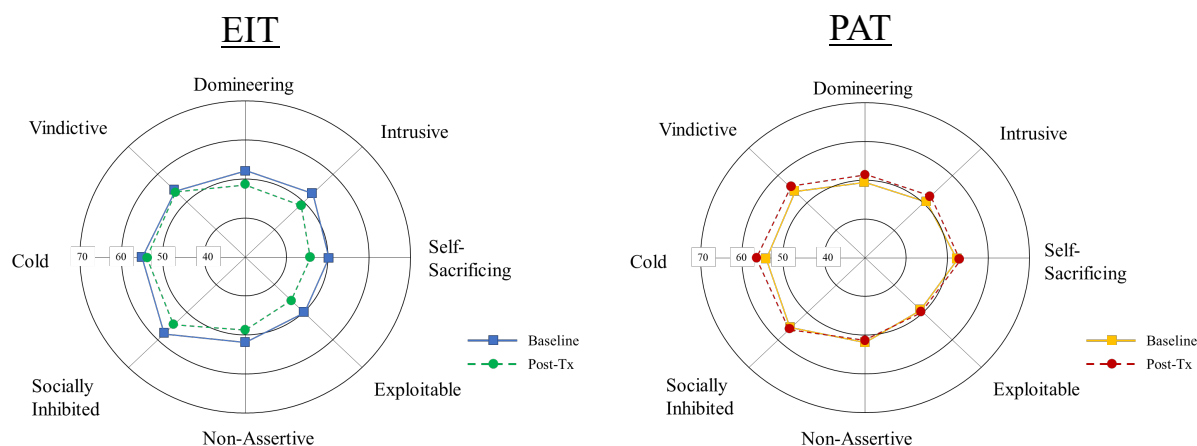
overall PAI antisocial scores following training (see **Figure 74**),  $F(1, 152) = 3.05, p = .083, \eta_p^2 = .02$ . This interaction was significant for the stimulus seeking subscale,  $F(1, 152) = 3.94, p = .049, \eta_p^2 = .03$ , but the antisocial behavior ( $p = .171$ ) and egocentricity ( $p = .869$ ) subscales were non-significant.

*Interpersonal Problems:* To gather a comprehensive picture of interpersonal difficulties, we administered the short-form Inventory of Interpersonal Problems (IIP-32; (Horowitz et al., 2000)). This inventory measures common interpersonal difficulties expressed by patients in therapy. The IIP-32 is based on the interpersonal circumplex which characterizes problems in terms of interpersonal warmth-coldness and dominance-submission. The circumplex has eight octants reflecting problems related to being domineering or controlling (dominance), being vindictive and self-centered (cold-dominance), being cold or distant (coldness), being social inhibited (cold-submissiveness), having a lack of assertiveness (submissiveness), being exploitable and overly accommodating (warm-submissiveness), being overly nurturing and self-sacrificing (warmth), and being intrusive (warm-dominance).



**Figure 75.** Changes in IIP-32 interpersonal problems as a function of time and program assignment.

There was a significant difference in overall IIP-32 scores,  $F(1, 154) = 5.09, p = .025$  (see **Figure 75**). As illustrated in **Figure 76**, individuals in the PAT program did not differ in their IIP scores between baseline and post-training assessments, whereas individuals in the EIT program showed a decrease in reported problems. For specific interpersonal problems, participants in the EIT program showed decreases in problems related to being domineering, socially inhibited, overly accommodating, self-sacrificing, and intrusive,  $ps = <.001-.016$ . Individuals in the PAT did not

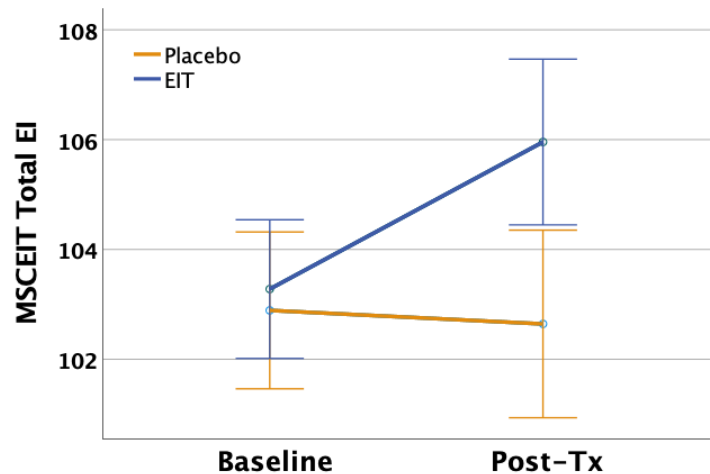


**Figure 76.** Changes in interpersonal problems between baseline and post-tx for the EIT group (left) and PAT group (right). Participants in the EIT group saw significant improvements to problems related to being domineering, socially inhibited, exploitable, self-sacrificing, and intrusive.

show any significant changes differ on any of the interpersonal problems between baseline and post-training.

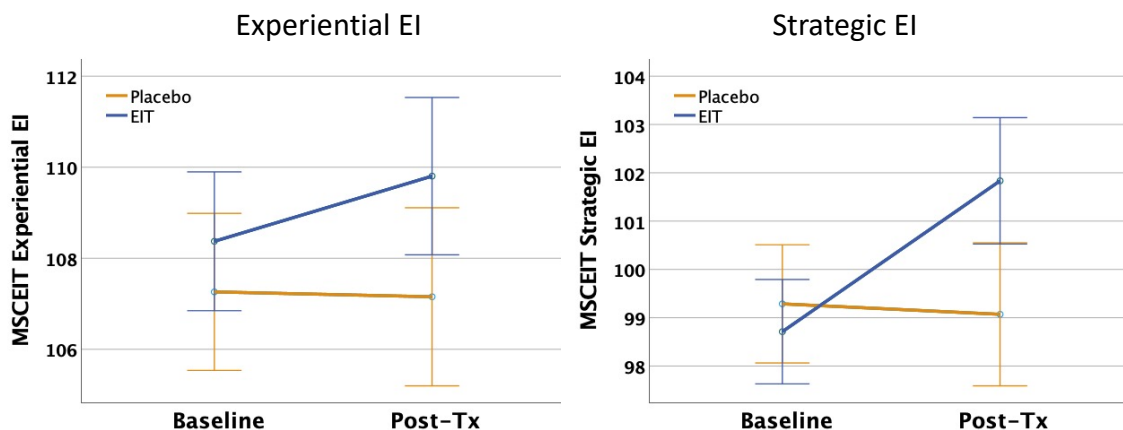
**Emotional Intelligence:** We examined the data to identify whether the EIT program was more effective than the placebo program at improving EI, using the flexible online approach. Initially, we identified that many individuals did not appear to be highly engaged in the assessment process, as evident by the Scatter Score of the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT 2), which provides evidence of inconsistent responding. Therefore, we screened participants to eliminate data that was suggestive of inconsistent effort or inattentive responding. This was done by excluding participants who scored more than 2 standard deviations above the mean scaled score for the MSCEIT scatter and the PAI Inconsistency and Infrequency scales.

After removing these outlier inconsistent responders, we subjected the data to a 2 (session) x 2 (training condition) mixed ANOVA, controlling for MSCEIT scatter scores, participant education, years of active military service, and measured aggression. As shown in Figure 2, we found that the EIT program led to greater improvement in MSCEIT Total EI scores (i.e., session x training condition interaction),  $F(1,136) = 3.97$ ,  $p = .048$  (see **Figure 77**). This suggests that the program was effective as intended, consistent with the outcomes from our prior samples with Tasks 3, 4, and 5.



**Figure 77.** The EIT program was associated with significantly improved MSCEIT Total EI scores compared to the placebo condition ( $p < .05$ ).

We followed up by conducting similar analyses for the two MSCEIT Area Scores, including Experiential EI and Strategic EI. For Experiential EI, the session x training condition interaction was not significant,  $F(1,136) = 0.61$ ,  $p = .436$ . However, as evident in **Figure 78**, there was a

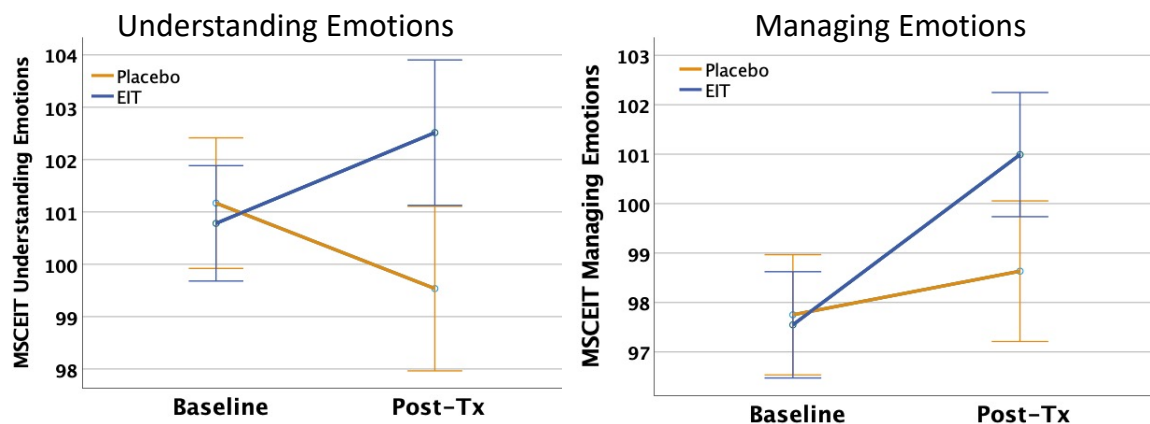


**Figure 78.** The EIT program did not significantly improve the Experiential EI Area Score, but was associated with significantly improved performance on the Strategic EI Area Score ( $p < .05$ ).



significant interaction for Strategic EI,  $F(1,136) = 5.26, p = .023$ , suggesting that the EIT program led to a significant enhancement of those skills relative to the placebo condition.

The Strategic EI Area Score is comprised of two Branch Scores, including Understanding Emotions and Managing Emotions. Since this Area Score was significant, we examined each of the contributing Branch Scores individually. As shown in **Figure 79**, there was a significant session x training condition interaction for the ability to understand emotions,  $F(1,136) = 4.256, p = .041$ . However, the interaction for the ability to manage emotions only reached a marginal level of significance,  $F(1,136) = 3.597, p = .06$ . Thus, the initial analyses appear to be supporting the hypothesis that the EIT program is effective at building some EI skills, particularly the ability to understand emotions, and perhaps to manage those emotions effectively.



**Figure 79.** The EIT program significantly improved the Understanding Emotions Branch Score ( $p < .05$ ) and led to a marginal improvement in the Managing Emotions Branch ( $p = .06$ ).

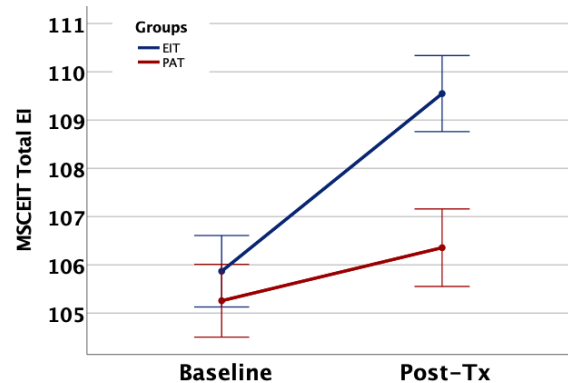
**Hypothesis 2.** *The optimized EI Training Program will yield significantly lower PSS scores and higher HRV (mean and slope) following deployment (or FTX) than the matched Placebo Training Program.*

Due to COVID restrictions and protocol changes, we were unable to collect HRV data, as this would require in-person contact to collect. We were able to collect global PSS scores (Cohen et al., 1983) at baseline and post-training. However, there was no significant time x program condition interaction,  $F(1, 156) = .87, p = .352, \eta_p^2 = .01$ , suggesting that the EIT program did not significantly reduce global self-reported stress. It is still uncertain of how the EIT program would impact objective assessments of stress or how EIT might benefit SMs going through a particular period of stress (e.g., deployment or field training). Future research will want to revisit this question once COVID restrictions are lifted.

**Conclusion:** Task 6 aimed to demonstrate the effectiveness of the EI training in military relevant contexts. Active-duty military personnel who took the EIT program showed significant improvements on key mental health and interpersonal outcomes such as depression, suicidality, and aggression. Overall, Task 6 further demonstrates that the EIT program enhances the emotional competencies of active-duty military personnel.

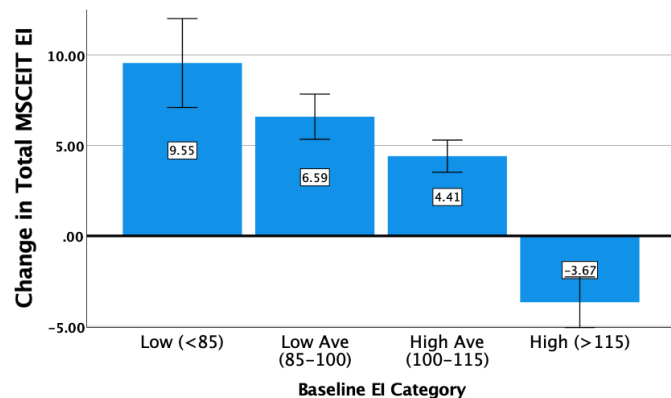
### 3.7 Overall Effects and Conclusion

Overall, we found that the EIT Program led to a significant improvement in EI skills, emotional competencies, resilience and mental health. As a final assessment we combined all usable MSCEIT Total score data ( $n = 734$ ) across all intervention groups (i.e., Tasks 3, 4, 5, and 6). The combined sample showed a clear interaction effect  $F(1,732) = 7.04, p = .008$ , suggesting that across the entire project, EIT was associated with a significant increase in Total EI relative to PAT (see **Figure 80**).



**Figure 80.** When complete data from all Task groups were combined ( $n = 734$ ), the EIT program demonstrated superior improvement in MSCEIT scores compared to the PAT.

Moreover, we found that, across all Task studies, the program was most effective for helping those who started the program with lower measured EI skills,  $F(3, 370) = 13.13, p < .000001$ . Specifically, those who began the EIT program with a MSCEIT score of 85 or less (i.e., in the low to impaired range) tended to show a mean increase of 9.6 points (SD = 14.6) following training. Those who were in the low average range between 85 to 100 on their MSCEIT scores at baseline tended to improve about 6.6 points (SD = 11.3). Those in the average to high-average range between 100 and 115 at baseline tended to improve about 4.4 points (SD = 10.8). However, those who were far above average, scoring above 115 at baseline, tended to decline slightly by about 3.7 points (SD = 14.7) (**Figure 81**). These findings suggest that the EIT program is: 1) most beneficial for those who begin with some deficits in basic emotional skills, 2) is somewhat helpful in the intermediate range, and 3) has little benefit for those who are highly competent in emotional skills to begin with. This suggests that the program is operating as intended and improving skills for those most at risk for emotional struggles. However, future improvements to the program may begin to address the potential need for additional skill development for those at the higher end of the continuum.



**Figure 81.** When complete EIT data from all Task groups were combined ( $n = 374$ ), the greatest improvements were seen for those who started with the lowest baseline MSCEIT scores. Individuals with low EI improved nearly 10 points, while those with the highest level of EI showed a non-significant decline in scores.

**Conclusion:** Over 6 major Tasks, we have developed and validated a comprehensive web-based EI training program that is based on extensive empirical literature and theory. We have programmed it into an engaging game-like interface and have validated it through a series of studies in civilian and military samples that have consistently shown that it improves multiple aspects of EI, emotional competencies, resilience, and mental health.

## 4. IMPACT

### **What was the impact on the development of the principal discipline(s) of the project?**

The initial findings from this program of research have already led to significant interest from the research community regarding the potential for training Emotional Intelligence skills. In 2019, we published an initial paper on the preliminary version of the EIT program, which has already been cited numerous times since its publication. Another paper concerning the benefits of EI training during the COVID-19 pandemic, was published in 2021 and has been cited 14 times in the past year. Numerous other publications are currently under review or being prepared for submission.

Our team has also published several theoretical papers about our revised models of emotional intelligence and emotional awareness, which has gathered considerable interest from the affective neuroscience community. In addition, we have had several companies show interest in acquiring or further developing the program for commercial use.

### **What was the impact on other disciplines?**

We have been contacted by members of the military community who are interested in using the program within ongoing military training courses. The PI has been contacted by several groups within the military, including the Army and Navy, who are interested in moving the EIT Program forward. Given the current COVID-19 pandemic and its effects on mental health, there has been interest in potentially using the program as a method for preventing depression, anxiety, and suicidal ideation.

### **What was the impact on technology transfer?**

We had discussed the possibility of obtaining a patent on the EIT program with Tech Launch Arizona, but they have determined that the current state of the program, as run in the Smart Sparrow platform would not constitute a patentable technology. We are currently seeking funding to a) transfer the program to a more flexible platform for widespread dissemination and b) explore further uses of the program, such as tailoring modules for improving specific mental health difficulties that Service members might face (e.g., interpersonal violence; suicidal ideation). We have submitted a number of grants to the Peer Reviewed Medical Research Program (PRMRP) and various DoD funding agencies to move this program forward but have thus far not been successful in securing further funding. As the current version of the EIT program runs on a proprietary software that is no longer supported (the company that supported it has now dissolved), it will be critical to move this technology forward to a new platform so that it can be disseminated widely to the military and dependent family members.

### **What was the impact on society beyond science and technology?**

Nothing to report.

## 5. CHANGES/PROBLEMS

### **Changes in approach and reasons for change:**

**COVID-19:** The COVID-19 pandemic created significant disruptions that led to a number of critical anticipated changes in the research protocol. As a result of the COVID-19 pandemic and

social distancing policies enacted, we had to temporarily halt data collection for the Task 3 baseline and post-training assessment sessions. All data collection was originally intended to be done in-person but following the onset of the COVID-19 pandemic, we transitioned our data collection protocols so that data could be collected remotely via an internet-based survey software (Qualtrics). This required extensive re-working of our assessment procedures and involved transitioning all procedures to a computer-administered virtual platform. To transition the data collection protocol to remote testing, we removed any measures that required in-person contact (e.g., heart rate variability) or specialized software (e.g., the UCLA empathetic accuracy test). We simplified protocols that included ambitious in-person testing, such as the initial Task 6 study design that would have required travel to military installations for in-person assessments. We also shortened the study protocol to reduce participant burden, as we could not monitor for fatigue or inattention as we could during in-person assessment sessions. This was achieved by removing any non-essential or excessively long measures. Finally, we removed the strict training program schedule and instead allowed participants to flexibly complete their training any time within a three-week period. These changes affected a subset of Task 3 & 5's baseline, training, and post-training assessments, all of Task 3's long-term follow up assessments, and all of task 4 & 6's baseline and post-training assessments.

***Smart Sparrow to InSpark Migration:*** The EIT program was originally scripted in a proprietary software platform known as Smart Sparrow. The UA originally contracted with Smart Sparrow to assist in developing and programming the EIT program and was promised a final “stand alone” program upon completion of the project. The stand-alone program was supposed to allow direct hand-off to the military and would allow the program to run on any web-server or computer operating system. However, in 2019, the Smart Sparrow company informed us that they had sold their company and would be going out of business at the end of 2020. Consequently, the program would no longer be supported. We identified a small start-up company located at Arizona State University that was running a clone version of the Smart Sparrow platform and they offered to continue to allow us to run our EIT and PAT programs off of their platform for a nominal fee. We agreed to utilize their services during 2020-2021 to allow the current project to be completed on time without significant interruption. Thus, the data collection for this project was completed successfully. However, the current version of InSpark is also now being phased out and will no longer be supported either. Consequently, it will be necessary for future work with the EIT program to migrate it over to a new stable platform such as Unity or something comparable that would allow wide dissemination of the program on a variety of platforms.

***Amendments:*** Over the course of the study, we made a number of changes to the study documents and protocols. Below is a list of amendments approved by the local IRB.

***Amendment #1 (Approved by local IRB: 09/21/2016):***

This minor amendment added a certificate of confidentiality obtained from NHLBI (National Heart, Lung, and Blood Institute).

***Amendment #2 (Approved by local IRB: 10/18/2016):***

This major amendment added Appendix F (waiver of consent/PHI) for the online eligibility screening questionnaire, as this eligibility screening portion of the study asks prospective subjects to self-report some medical information.

Amendment #3 (Approved by local IRB: 11/17/2016)

This major amendment added MAAS, MAIA, PSS, and EQ-i to assessments, removed unnecessary screening questions, updated recruitment materials, updated compensation, time requirement, and language in the ICF.

Amendment #4 (Approved by local IRB: 04/03/17)

This major amendment updated Task 2 procedures, compensation, and risks of participation for a second iteration of program testing, added questionnaires (SSS, caffeine consumption, subject feedback questionnaire), and added new advertisements and scheduling instructions to improve Task 2 subject recruitment.

Amendment #5 (Approved by local IRB: 04/27/2017)

This minor amendment added information about the EIT program and added initial storyboards for EIT modules.

Amendment #6 (Approved by local IRB: 05/08/2017)

This minor amendment revised the ICF to add information about EKG procedures and risks.

Amendment #7 (Approved by local IRB: 06/02/2017)

This minor amendment updated the study personnel list.

Amendment #8 (Discarded by local IRB)

This amendment was submitted but not documented nor assigned to IRB review. We believe that our IRB study renewal request may have erroneously been submitted as this amendment and the amendment was discarded once the error was caught.

Amendment #9 (Approved by local IRB: 08/01/2017):

This minor amendment updated the study personnel list.

Amendment #10 (Approved by local IRB: 12/11/2017):

This minor amendment revised the consent form and consenting script, decreased the time required for study visits, updated the study personnel list, and included a new iteration of the EIT program modules.

Amendment #11 (Approved by local IRB: 12/18/2017):

This minor amendment corrected a small error in the Task 2 study interest form.

Amendment #12 (Approved by local IRB: 01/08/2018):

This minor amendment corrected a small error in subject instructions.

Amendment #13 (Approved by local IRB: 03/29/2018):

This minor amendment included placebo training modules, updated advertising for general recruitment purposes, and added recruitment and instructions for active-duty military participants.

Amendment #14 (Approved by local IRB: 05/11/2018):

This major amendment documented a reportable event in which it was discovered that some staff were providing participants with unsigned copies of the ICF rather than copies of the signed forms obtained during the consenting process.

*Amendment #15: (Approved by local IRB: 05/14/2018):*

This major amendment documented a reportable event in which an email was sent to a participant using another participant's name.

*Amendment #16 (Approved by local IRB: 05/30/2018):*

This minor amendment corrected the consent form and training instructions for military personnel.

*Amendment #17 (Approved by local IRB: 06/07/2018):*

This minor amendment added radio recruitment advertisements and updated the study personnel list.

*Amendment #18 (Approved by local IRB: 08/30/2018):*

This major amendment added ROTC instructors to the research population of interest, waived documentation of consent for Task 5 (ROTC) subjects. This amendment added recruitment materials, information for screening and scheduling, ICFs, and instructions for completing the training program for Task 3-5. It also added new assessments for Tasks 3-5 including the BDI-II, BPAQ, CAMS-R, CART, CD-RISC, CISS, CRA Task, COPE, CRT-7, DERS, and DRS-15, eLEAS, Empathetic Accuracy Task, EROS, ERQ, FFMQ, Flourishing Scale, GERT-S, Grit Scale, Horizon Task, IPART, LAI, Limited Offer Task, Markov Aliens Task, MEAQ, MEOS, MEPS, MFQ-30, MINI-K, MUSE, NASA-TLX, PANAS, PAT, PSQI, SMQ, STAI, STEM-B, Syllogisms Task, TAS-20, TASIT-S, TEIQue, Trauma Questionnaire, and WASI-II.

*Amendment #19 (Approved by local IRB: 11/16/2018):*

This minor amendment added a subject feedback questionnaire to Tasks 3 & 5.

*Amendment #20 (Approved by local IRB: 04/29/2019):*

This minor amendment added additional information concerning risks for individuals who use tobacco products and added questions about tobacco use and traumatic brain injury.

*Amendment #21 (Approved by local IRB: 08/26/2019):*

This minor amendment made small revisions to study material for clarity, added the Flourishing scale to the Task 3 study protocol, added debriefing information to Task 3, and updated the study personnel list.

*Amendment #22 (Approved by local IRB: 10/09/2019):*

This minor amendment made small changes to material for clarity, modified Task 5 time requirement for study visits, added the Short Dark Triad Scale to the study protocol, and added instructional documents that would help increase study compliance.

*Amendment #23 (Approved by local IRB: 04/29/2020):*

This major amendment clarified research locations, MRI procedures/devices, and protocol for handling incidental MRI findings; added recruitment from external (i.e., non-UA) ROTC programs

and Davis-Monthan Air Force Base; removed ROTC instructors from the target population of interest and removed WRAIR and Comprehensive Soldier and Family Fitness as collaborators; updated subject information and other study documentation for clarity and accuracy.

*Amendment #24 (Approved by local IRB: 04/30/2020):*

This major amendment documented a planned deviation from the study protocol in order to cancel additional in-person study visits due the health and safety risks posed by the COVID-19 pandemic.

*Amendment #25 (Approved by local IRB: 07/10/2020):*

This major amendment finalized protocols for recruitment and data collection for Task 6, added Davis-Monthan Air Force Base (Tucson, AZ) as a recruitment site and added the Navel Postgraduate School (Monterrey, CA) as a recruitment and data collection site, added information and risks of Oura Rings. This amendment also updated the study personnel list.

*Amendment #26 (Approved by local IRB: 08/04/2020):*

This major amendment added a new ICF and general advertisements to allow for nationwide recruitment of active-duty military personnel, and added a verification survey to verify active-duty status and base affiliation.

*Amendment #27 (Approved by local IRB: 08/21/2020):*

This minor amendment removed the Navel Postgraduate School as a research site and revised ICFs and recruitment ads to transition Tasks 5 & 6 to remote study participation.

*Amendment #28 (Approved by local IRB: 10/02/2020):*

This minor amendment revised ICFs, recruitment ads, and subject material to transition tasks 3 & 4 to remote or semi-remote study participation and added protocols to reduce possible risk of COVID-19 transmission, including PPE requirements, zoom screenings, and wellness screenings. This amendment also made small changes in wording to clarify instructions.

*Amendment #29 (Approved by local IRB: 11/10/2021):*

This minor amendment updated advertisements for recruiting active-duty military participants.

*Amendment #30 (Approved by local IRB: 01/19/2021):*

This major amendment removed Davis-Monthan Air Force Base as an active recruitment site and added information about the EIT program's non-significant risk device determination.

*Amendment #31 (Approved by local IRB: 02/17/2021):*

This minor amendment increased enrollment numbers to account for missing or unusable data and broadened language used for technical support details so that study staff could efficiently provide participants needing technical support with the most up-to-date information.

*Amendment #32 (Approved by local IRB: 03/04/2021):*

This minor amendment revised language in the recruitment and screening materials than allowed active-duty participants to specify where they heard about the study, lets them indicate whether they would like to be contacted for future studies, and encourages them to share study information with eligible friends and coworkers.



Amendment #33 (Approved by local IRB: 03/23/2021):

This minor amendment added additional advertising for recruiting active-duty participants, and added compensation and information about confidentiality for Task 5 transcripts and ROTC records data collection.

Amendment #34 (Approved by local IRB: 05/27/2021):

This major amendment documented a reportable event regarding the Task 6 (active-duty) eligibility determination protocol, removed the active-duty military ID requirement, and updated military verification instructions.

Amendment #35 (Approved by local IRB: 06/18/2021):

This minor amendment added new recruitment materials, added a questionnaire regarding thoughts, beliefs, and experiences relating to the COVID-19 pandemic to the Task 3 follow-up assessment, increased the sample size of the Task 3 follow-up sample, and updated the study personnel list.

**Actual or anticipated problems or delays and actions or plans to resolve them**

This study has concluded and there are therefore no ongoing problems to report.

**Changes that have a significant impact on expenditures**

Nothing to Report

**Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents.**

Nothing to Report

## **6. PRODUCTS**

### **Publications, Conference Papers, and Presentations**

#### ***Publications***

Smith, R., Bajaj, S., Dailey, N. S., Alkozei, A., Smith, C., Sanova, A., Lane, R. D., & Killgore, W. D. S. (2018). Greater cortical thickness within the limbic visceromotor network predicts higher levels of trait emotional awareness. *Conscious Cognition*, 57, 54-61.

Smith, R., Killgore, W. D. S., Alkozei, A., & Lane, R. D. (2018). A neurocognitive process model of emotional intelligence. *Biological Psychology*, 139, 131-151.

Smith, R., Killgore, W. D. S., & Lane, R. D. (2018). The structure of emotional experience and its relation to trait emotional awareness: A theoretical review. *Emotion*, 18, 670-692.

Smith, R., Lane, R. D., Alkozei, A., Bao, J., Smith, C., Sanova, A., Nettles, M., & Killgore, W. D. S. (2018). The role of medial prefrontal cortex in the working memory maintenance of one's own emotional responses. *Scientific Reports*, 8, 3460.

Smith, R., Lane, R. D., Sanova, A., Alkozei, A., Smith, C., & Killgore, W. D. S. (2018). Common and unique neural systems underlying the working memory maintenance of emotional vs. bodily reactions to affective stimuli: The moderating role of trait emotional awareness. *Frontiers in Human Neuroscience*, 12, 370.

Smith, R., Sanova, A., Alkozei, A., Lane, R. D., & Killgore, W. D. S. (2018). Higher levels of trait emotional awareness are associated with more efficient global information integration throughout the brain: A graph-theoretic analysis of resting state functional connectivity. *Social, Cognitive and Affective Neuroscience*, 13, 665-675.

Alkozei, A., Smith, R., Demers, L. A., Weber, M., Berryhill, S. M., & Killgore, W. D. S. (2019). Increases in emotional intelligence after an online training program are associated with better decision-making on the Iowa Gambling Task. *Psychological Reports*, 122(3), 853-879.

Smith, R., Alkozei, A., & Killgore, W. D. S. (2019). Parameters as trait indicators: Exploring a complementary neurocomputational approach to conceptualizing and measuring trait differences in emotional intelligence. *Frontiers in Psychology*, 10, 848.

Vanuk, J. R., Alkozei, A., Raikes, A. C., Allen, J. J. B., and Killgore, W. D. S. (2019). Ability-based emotional intelligence is associated with greater cardiac vagal control and reactivity. *Frontiers in Human Neuroscience*, 13, Article 181, doi: 10.3389/fnhum.2019.00181

Persich, M.R., Smith, R., Cloonan, S.A., Woods-Lubbert, R., Strong, M., & Killgore, W.D.S. (2021). Emotional intelligence as a protective factor for mental health during the COVID-19 pandemic. *Depression and Anxiety*, 38, 1018-1025.

Killgore, W. D. S., Vanuk, J.R., Persich, M.R., Cloonan, S.A., Gradner, M.A., & Dailey, N.S. (2022). Sleep quality and duration are associated with greater trait emotional intelligence. *Sleep Health*, 8(2), 230-233.

Smith, R., Persich, M.R., Lane, R.D., & Killgore, W.D.S. (2022). Higher emotional awareness is associated with greater domain-general reflective tendencies. *Scientific Reports*, 12, 3123.

Smith, R., Taylor, S., Wilson, R. C., Chuning, A. E., Persich, M. R., Wang, S., & Killgore, W. D. S. (2022). Lower levels of directed exploration and reflective thinking are associated with greater anxiety and depression. *Frontiers in Psychiatry*, 12, [doi.org/10.3389/fpsy.2021.782136](https://doi.org/10.3389/fpsy.2021.782136)

Persich, M.R., Smith, R., Cloonan, S.A., Woods-Lubbert, R., Skalamera, J., Berryhill, S.M., ... & Killgore, W.D.S. (2021). Development and validation of an online emotional intelligence training program. Manuscript Submitted.

Smith, R., Persich, M.R., Cloonan, S., Woods-Lubbert, R., Skalamera, J., Berryhill, S.M., Weihs, K.L., Lane, R.D., Allen, J.J.B., Dailey, N.S., Alkozei, A., Vanuk, J.R., & Killgore, W.D.S. (2021). Improvements in mindfulness, interoceptive and emotional awareness, emotion regulation, and interpersonal emotion management following completion of an online emotional skills training program. Manuscript Submitted.

***Books or Other Non-Periodical One-Time Publications***

Cloonan, S.A., Taylor, E.C., Persich, M.R., Dailey, N.S., & Killgore, W.D.S. (2021). Sleep and resilience during the COVID-19 pandemic. In Gabrielli, F, and Irtelli, F. (Eds.). *Anxiety, Uncertainty, and Resilience During the Pandemic Period – Anthropological and Psychological Perspectives*, IntechOpen.

***Other Publications, Conference Papers, and Presentations***

Bajaj, S., Raikes, A.C., Alkozei, A., Dailey, N.S., Satterfield, B.C., Vanuk, J.R., & Killgore, W.D.S. Association between suicidal ideation and cortical volume in a sub-clinical sample of young individuals. Abstract presented at the Society of Biological Psychiatry 73rd Annual Meeting, New York, NY, May 10-12, 2018.

Bajaj, S., Raikes, A.C., Alkozei, A., Dailey, N.S., Satterfield, B.C., Vanuk, J.R., & Killgore, W.D.S. Association between suicidal ideation and cortical volume in a sub-clinical sample of young individuals. Abstract presented at the Society of Biological Psychiatry 73rd Annual Meeting, New York, NY, May 10-12, 2018.

Bajaj, S., & Killgore, W.D.S. Sex differences in limbic and risk-taking propensity in healthy individuals. Abstract accepted for presentation at the Organization for Human Brain Mapping Annual Meeting, June 9-13, 2019.

Skalamera, J., Huang, Y.H., Chinkers, M., Richards, M.M., & Killgore, W.D.S.. The influence of habitual sleep duration on rational thinking ability. Abstract accepted for presentation at the 2019 Annual Meeting of the Associated Professional Sleep Societies (SLEEP) Conference, San Antonio TX, June 8-12, 2019.

Smith, R., Sanova, A., Lane, R.D., & Killgore, W.D. Graph-theoretic correlates of trait differences in emotional awareness. Abstract presented at the Society of Biological Psychiatry 73rd Annual Meeting, New York, NY, May 10-12, 2018.

Vanuk, J.R., Smith, R., Raikes, A.C., Alkozei, A., Skalamera, J., & Killgore, W.D.S. Ability based emotional intelligence is associated with greater cardiac vagal tone. Abstract presented at the Annual Meeting of the International Neuropsychological Society (INS), New York, NY, February 20-23, 2019.

Vanuk, J.R., Shields, S., Slavich, M., & Killgore, W.D.S. Lifetime stress exposure during adulthood is associated with lower trait-based emotional intelligence. Abstract presented at the Annual Meeting of the American Psychosomatic Society, Vancouver, BC, March 6-9, 2019.

Skalamera, J., Huang, Y.H, Chinkers, M., Richards, M.M., & Killgore, W.D.S. The influence of habitual sleep duration on rational thinking ability. Poster presented at the Annual SLEEP Meeting, San Antonio, TX, June 8-12, 2019.

Vanuk, J. (September, 2019). *Lifetime stress exposure during adulthood is associated with lower emotional intelligence*. Abstract submitted to the 2020 Meeting of the International Neuropsychological Society, Denver, CO.

Killgore, W.D.S., (October, 2019). *Preliminary validation of a web-based emotional intelligence training program for enhancing emotional resilience*. Abstract submitted to the 40th meeting of the Anxiety and Depression Conference, San Antonio, TX.

Killgore, W.D.S. (October, 2019). *Political perspective is associated with differences in trait anxiety and depression*. Abstract submitted to the 40th meeting of the Anxiety and Depression Conference, San Antonio, TX.

Cloonan, S., Persich, M., Woods-Lubbert, R., Smith, R., Skalamera, J., & Killgore, W.D.S. (February, 2021). *Examining changes to perceived and ability emotional intelligence following emotional intelligence-specific training*. Poster presented at the 2021 Meeting of the International Neuropsychological Society, San Diego, CA, February 2-5, 2021.

Killgore, W.D.S., Cloonan, S., Woods-Lubbert, R., Vanuk, J., Persich, M., Dailey, N., Strong, M., King, R., & Lane, R. (February, 2021). *Enhancing emotional awareness with an online training program*. Poster presented at the 2021 Meeting of the International Neuropsychological Society, San Diego, CA, February 2-5, 2021.

Killgore, W.D.S., Cloonan, S., Woods-Lubbert, R., Vanuk, J., Persich, M., Dailey, N., Strong, M., King, R., Lane, R., & Smith, R. (February, 2021). *Can emotional resilience be trained?* Poster presented at the 2021 Meeting of the International Neuropsychological Society, San Diego, CA, February 2-5, 2021.

Killgore, W.D.S., Cloonan, S., Woods-Lubbert, R., Vanuk, J., Persich, M., Dailey, N., Strong, M., King, R., Lane, R., & Smith, R. (February, 2021). *Training interoceptive awareness*. Poster presented at the 2021 Meeting of the International Neuropsychological Society, San Diego, CA, February 2-5, 2021.

Killgore, W.D.S., Skalamera, J., Ozcan, M., Cloonan, S., Woods-Lubbert, R., Persich, M., & Smith, R. (February, 2021). *Development and validation of the Interpersonal Affect Regulation Test (IPART)*. Poster presented at the 2021 Meeting of the International Neuropsychological Society, San Diego, CA, February 2-5, 2021.

Persich, M., Cloonan, S., Woods-Lubbert, R., Smith, R., Skalamera, J., & Killgore, W.D.S. (February, 2021). *Emotional intelligence training and improvements to emotion regulation*. Poster presented at the 2021 Meeting of the International Neuropsychological Society, San Diego, CA, February 2-5, 2021.

Cloonan, S., Persich, M., Woods-Lubbert, R., Skalamera, J., Smith, R., & Killgore, W.D.S. (February, 2021). *Improving emotion regulation abilities through an interactive, online emotional intelligence training program*. Poster presented at the 2021 Society of Personality and Social Psychology Annual Convention – Emotion Preconference, February 10, 2021.

Persich, M., Cloonan, S., Woods-Lubbert, R., Strong, M., & Killgore, W.D.S (February, 2021). *The benefits of emotional intelligence during the COVID-19 pandemic*. Poster presented at the 2021 Society of Personality and Social Psychology Annual Convention – Emotion Preconference, February 10, 2021.

Cloonan, S., Persich, M., & Killgore, W.D.S. (March, 2021). *Resilience mediates the effect of actual and perceived emotional intelligence on depression*. Abstract submitted to the 2021 Military Health System Research Symposium.

Persich, M., Cloonan, S., Grandner, M., Killgore, W.D.S. (June, 2021). *Sleep quality and duration are associated with greater trait emotional intelligence*. Poster presented at the Annual 2021 SLEEP Meeting.

Persich, M., Cloonan, S., Grandner, M., Killgore, W.D.S. (June, 2021). *Self-reported sleep and resilience*. Poster presented at the Annual 2021 SLEEP Meeting.

Killgore, W.D.S., Persich, M.R., Cloonan, S.A., Vanuk, J.R., Dailey, N.S., & Smith, R. (2021, August). *Development and validation of a military emotional intelligence training program for enhancing emotional resilience*. Abstract accepted for presentation at the 2021 Military Health System Research Symposium.

Persich, M.R., Cloonan, S.A., & Killgore, W.D.S. (2021, August). *Enhancing interoceptive awareness and dispositional mindfulness through a military emotional intelligence training program*. Abstract accepted for presentation at the 2021 Military Health System Research Symposium.

Chuning, A., Talyor, S., & Smith, R., Cloonan, S., Persich, M., & Killgore, W. D. S. (October 2021). *The Influence of Resiliency on the Relationship Between Affective Disorder Symptoms and Flourishing*. Abstract submitted to the Anxiety & Depression Association of America 2022 Annual Conference.

Cloonan, S.A., Persich, M.R., Bullock, A., Anlap, I., Wellman, C., Swift, N., Johnson, J., King, R., Warren, M., & Killgore, W.D.S. (2022, February). *Further validation of an online, evidence-based emotional intelligence training program in a flexible, fully online setting*. Poster presented at the Society of Personality and Social Psychology 2022 Annual Convention.

Killgore, W. D. S., Persich, M. R., Cloonan, S. A., Vanuk, J. R., Dailey, N. S., & Smith, R. (2022). *Building military resilience through training: Phase I – development and preliminary validation of a military emotional intelligence training (EIT) program*. Abstract accepted for presentation at the 2022 Military Health System Research Symposium.

Killgore, W. D. S., Persich, M. R., Cloonan, S. A., Vanuk, J. R., Dailey, N. S., & Smith, R. (2022). *Building military resilience through training: Phase II – demonstration of effectiveness of an emotional intelligence training (EIT) program in military populations*. Abstract accepted for presentation at the 2022 Military Health System Research Symposium.

Persich, M. R., Smith, R., Cloonan, S. A., Vanuk, J. R., Dailey, N. S., Killgore, W. D. S. (2022). *Examining user experience: Implications for the feasibility, efficacy, and broader dissemination of an online emotional intelligence training program*. Abstract accepted for presentation at the 2022 Military Health System Research Symposium.

#### **Website(s) or other Internet site(s)**

Nothing to Report

#### **Technologies or Techniques**

Nothing to Report

#### **Inventions, patent applications, and/or licenses**

We discussed patent protection with the TechLaunch Arizona. We filed an invention disclosure, but were informed that the program is not patentable. Meanwhile, we have several companies that are interested in licensing the product or starting a company with us.

#### **Other Products**

The EIT and PAT programs are complete in their entirety. They currently reside on a server at Arizona State University for administration using their *InSpark* platform. We are maintaining them on that platform so that they will be ready for further modification and migration to a new platform at such time as we secure funding to do so.

## **7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS**

### **What individuals have worked on the project?**

#### ***Financial Information for the Current Reporting Period***

Name: William D. “Scott” Killgore, Ph. D.

Project Role: PI

Nearest person month worked: 1.26

Contribution to project: Dr. Killgore oversees all aspects of project progress and orchestrates data analysis and publication efforts.

Funding Support: W81XWH-12-1-0386  
W81XWH-14-1-0570  
W81XWH-14-1-0571

Name: Natalie Dailey, Ph.D.

Project Role: Postdoctoral Fellow

Nearest person month worked: 2.25

Contribution to project: Dr. Dailey performs data analysis and processing for the project.

Funding Support: W81XWH-12-1-0386  
W81XWH-14-1-0570  
W81XWH-14-1-0571

Name: Michelle Persich, Ph.D.  
 Project Role: Postdoctoral Fellow  
 Nearest person month worked: 3.00  
 Contribution to project: Dr. Persich performs data analysis and processing for the project.  
 Funding Support: W81XWH-12-1-0386  
                           W81XWH-14-1-0570  
                           W81XWH-14-1-0571

Name: Kimberly Henderson  
 Project Role: Research Technician  
 Nearest person month worked: 3.00  
 Contribution to project: Ms. Henderson provides support with data cleaning activities.  
 Funding Support: W81XWH-12-1-0386  
                           W81XWH-14-1-0570  
                           W81XWH-14-1-0571

Name: Samantha Jankowski  
 Project Role: Research Technician  
 Nearest person month worked: 2.85  
 Contribution to project: Ms. Jankowski provides support with data cleaning activities.  
 Funding Support: W81XWH-12-1-0386  
                           W81XWH-14-1-0570  
                           W81XWH-14-1-0571

Name: Camryn Wellman  
 Project Role: Research Technician  
 Nearest person month worked: 0.84  
 Contribution to project: Ms. Wellman provides support with data cleaning activities.  
 Funding Support: W81XWH-12-1-0386  
                           W81XWH-14-1-0570  
                           W81XWH-14-1-0571

***Full list of individuals who have received pay for the research effort (alphabetical order by surname):***

<b>Name</b>	<b>Role</b>
Anna Alkozei, Ph.D.	Postdoctoral Fellow
Matthew Allbright	Research Technician
John J. B. Allen, Ph.D.	Co-PI
R. Ian V. Anlap	Research Technician
Sahil Bajaj, Ph.D.	Postdoctoral Fellow
Garrett Baker	Research Technician
Cameron A. Barnes	Research Technician
Sarah Berryhill	Study Coordinator
Renata Botello	Research Technician



Madison L. Brown	Research Technician
Leah N. Brunn	Research Technician
Ayla Bullock	Research Technician
Anna Burns	Research Technician
Skye Challener	Research Technician
Melissa Chaves	Research Technician
Miriam Chinkers	Research Technician
Sara Cloonan	Research Technician/Study Coordinator
Natalie Dailey, Ph.D.	Postdoctoral Fellow
James E. J. Del Toro	Research Technician
Elizabeth Dolbeck	Research Technician
Alyssa Dormer	Research Technician
Simon L. Esbit	Research Technician
Brittany Forbeck	Research Technician
Cyrena L. Gibson	Research Technician
Melissa Gottschlich	Research Technician
Paige L. Grafton	Research Technician
Trevor Grant	Research Technician
Janice Hayhoe	Research Technician
Kimberly Henderson	Research Technician
Yinya Huang	Research Technician
Simone Hyman	Research Technician
Samantha Jankowski	Research Technician
Jason R. Johnson	Research Technician
William D. S. Killgore, Ph.D.	PI
Rylee King	Research Technician
Sara Knight	Lab Manager
Kyle Lafollette	Research Technician
Richard D. Lane, MD; Ph.D.	Co-PI
Michael Lazar	Research Technician
Sarah Markowski	Study Coordinator
Jacqueline Marquez	Research Technician
Michael A. Milller	Research Specialist
Haley D. Minarik	Research Technician
Emily N. Morris	Research Technician
Meltem Ozcan	Research Technician
Michelle Persich, Ph.D.	Postdoctoral Fellow
Adam Raikes, Ph.D.	Postdoctoral Fellow
Daisy A. Raygoza	Research Technician
Molly M. Richards	Research Technician
Anna Sanova	Research Technician
Brieann Satterfield, Ph.D.	Postdoctoral Fellow
Kristin Caleigh Shepard	Research Technician

Alan G. Shoemaker	Research Technician
Anmol Singh	Research Technician
Jeffrey Skalamera	Research Technician/Study Coordinator
Ryan Smith, Ph.D.	Postdoctoral Fellow
Courtney Smith	Research Technician
Aaron D. Stone	Research Technician
Michael Strong	Research Technician
Nathan Swift	Research Technician
Emily Taylor	Lab Manager
Sierra M. Taylor	Research Technician
Matthew Thurston	Research Technician
Theodore P. Trouard	Co-PI
Lynette R. Valencia	Research Technician
John R. Vanuk	Graduate Student
Mark E. Wager	Research Technician
Michael Warren	Research Technician
Karen L. Weihs, MD	Co-PI
Camryn Wellman	Research Technician
Sydney Wilkerson	Research Technician
Rebecca A. Woods-Lubbert	Research Technician/Study Coordinator
Joseph Yee	Regulatory Coordinator
Angela Yung	Research Technician

## 8. SPECIAL REPORTING REQUIREMENTS

Please see updated Quad Chart attached in Appendix

## 9. REFERENCES

- Alkozei, A., Smith, R., Demers, L. A., Weber, M., Berryhill, S. M., & Killgore, W. D. S. (2019). Increases in emotional intelligence after an online training program are associated with better decision-making on the iowa gambling task. *Psychological Reports, 122*(3), 853-879.
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## **10. APPENDICES**

Appendix A: Quad Chart

Appendix B: Publications and Abstracts related to the project

Appendix C: Overview of the Emotional Intelligence Training (EIT) program

Appendix D: Overview of the Placebo Awareness Training (PAT) program

Appendix E: Detailed screenshots of the Emotional Intelligence Training (EIT) program

Appendix F: PI CV