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Reducing Anxiety Levels Through the Dharma Life App-Based and Mentor-Based Program Targeting Personality Characteristics: A Randomized Control Trial

Joshua Wilt[1,*], Monique Powell[2] and Steven Wronski[2]

[1]Department of Psychological Sciences, Case Western Reserve University, OH 44106, United States
[2]Dharma Life Sciences LLC, NY 10173, United States

Abstract:

Background: Personality factors and cognitive biases may contribute to anxiety. These associations suggest that interventions aimed at ameliorating such personality factors and their underlying cognitive biases may decrease anxiety. The Dharma Life Program uses an app- and mentor-based intervention that intends to ameliorate potentially maladaptive aspects of personality characteristics, such as cognitive biases. We predicted that the Dharma Life Program would lead to greater decreases in anxiety among individuals reporting difficulties with anxiety as compared to a no-treatment control condition.

Method: We recruited 43 participants through social media. Participants were randomly assigned to complete the Dharma Life Program or a no-treatment control group for eight weeks. The intervention and control groups completed baseline and follow-up measures of anxiety symptoms.

Result: Results showed that, although anxiety levels declined for participants in both conditions, participants in the Dharma Life Program group showed greater decreases over time, supporting our hypothesis that the program would ameliorate anxiety.

Conclusions: First, this study provides initial evidence that the Dharma Life Program may be effective in reducing anxiety. Second, the results also suggest more broadly that interventions targeting personality change through modifying cognitive biases may be helpful for people struggling with anxiety-related difficulties.

Clinical Trial Registration Number: NCT06138652.

Keywords: Personality, Anxiety, Personality change, App-based intervention, Mentor, Cognitive biases.

*Address correspondence to this author at the Department of Psychological Sciences, Case Western Reserve University, OH 44106, United States; E-mail: joshua.wilt@case.edu

1. INTRODUCTION

The purpose of this study is to test whether the Dharma Life Science program to address problematic personality traits may reduce anxiety for those struggling with anxiety. The program is based on the idea that personality may underlie anxiety, a position that is well-supported in the literature. Indeed, personality traits are known to be implicated in anxiety disorders [1-4]. The most consistent relationship between traits and anxiety is neuroticism. For instance, people high in neuroticism are more likely to have Generalized Anxiety Disorder [5], more severe anxiety symptoms [6], and experience more dysfunction when they have anxiety disorder [7]. Further, longitudinal studies show that neuroticism predicted the

development of anxiety disorders by young adulthood [4] and is a risk factor for panic attacks during adolescence [2]. Other traits are relevant to anxiety as well. Brandes and Bienvenu [7] found that people with lower extraversion have higher rates of specific phobias and social anxiety disorder. People with antisocial, borderline, dependent, depressive, histrionic, passive-aggressive, and schizotypal personality traits in adolescence and early adulthood are at greater risk for an anxiety disorder in middle adulthood, after controlling for baseline anxiety disorders [3].

If some personality traits are relevant to anxiety, it is possible that changes to such traits may relate to changes in the expression of anxiety symptoms. We were interested in whether helping people to change their traits related to problematic anxiety might reduce the severity of anxiety symptoms. Specifically, we evaluated whether the Dharma Life Sciences program to address problematic traits may help individuals who reported struggling with anxiety. This program relies on app-based and mentor-based training to help people identify and ameliorate potentially problematic personality traits [8]. Research on interventions for personality change is just beginning but suggests that short-term interventions may lead to meaningful change, and our research builds on this work by looking at the effects of an intervention targeting potentially maladaptive aspects of personality that could contribute to anxiety. If we find evidence supporting the effectiveness of the program, it may be a valuable option for people looking to reduce anxiety, and it may also signal the potential of app- and mentor-based programs more generally for helping to ameliorate anxiety through targeting personality traits. In the remainder of the introduction, we (a) review the literature on cognitive biases and anxiety, (b) describe the Dharma Life Sciences program and explain how it fits with the literature on personality change interventions, and (c) give an overview of our study, including our hypotheses.

1.1. Cognitive Biases and Anxiety

The Dharma Life Sciences program is based on altering cognitive biases. Cognitive biases play a significant role in the development and maintenance of anxiety disorders [9]. These biases are systematic errors in thinking and processing information that can lead individuals to interpret situations in a threatening or negative manner [10].

Several cognitive biases reinforce anxiety [11]. For instance, selective attention to threat-related information can lead individuals to focus on cues in their environment that confirm their anxious beliefs while ignoring evidence to the contrary. Overestimation of the likelihood and severity of potential threats makes everyday situations appear more dangerous than they really are. People who tend to interpret ambiguous information or situations in a negative way may experience more anxiety. For example, a person may interpret a neutral facial expression from someone as a sign of disapproval or rejection, leading to social anxiety. People with anxiety often recall past events in a way that reinforces their anxious beliefs, emphasizing

negative experiences while minimizing positive ones. These biases that reinforce anxiety may be associated with personality traits, particularly neuroticism [12] for a review). People with higher levels of neuroticism have a heightened sensitivity to negative stimuli and are more likely to exhibit cognitive biases such as catastrophizing, selective attention to threat-related information, and rumination. They may also be more prone to confirmation bias, where they selectively attend to information that confirms their negative beliefs. As individual differences in cognition are a component of personality [13], it is possible that various personality traits and characteristics relate to cognitive biases that could potentially underlie anxiety problems.

The idea that cognitive biases may be altered is consistent with the concept of neuroplasticity. Neuroplasticity is the capacity of the nervous system to change in response to experience. In the last two decades, research has demonstrated that the brain is not a static network of neurons, but instead, a plastic (changeable) organ that continuously grows and changes in response to an individual's genes and experiences [14]. Indeed, interventions aimed at reducing cognitive biases have been successful in reducing anxiety [15-17]. Cognitive bias modification programs specifically target cognitive biases by training individuals to interpret ambiguous or threatening information in a more positive or balanced manner [18, 19].

1.2. Dharma Life Sciences Program

The Dharma Life Sciences program follows the tradition of cognitive bias modification programs. In brief, it is designed to help people identify potentially problematic personality traits and then address the cognitive biases associated with such traits. We reasoned that, for people struggling with anxiety, reducing cognitive biases associated with personality traits that reinforce anxiety would be beneficial.

The intervention is also in line with a small but growing number of interventions for modifying aspects of personality [20]. For example, a 16-week study showed that setting specific "if-then" plans for personality-change goals led to trait changes [21]. Another 15-week study found that achieving behavioral change goals through consistent, specific actions predicted trait changes over time [22]. One study involved a 10-week personality-change coaching program [23], resulting in increased conscientiousness and extraversion and reduced negative emotionality [24]. Another explored the effects of a 5-week behavioral-activation training intervention, which increased conscientiousness facets [25]. While this research is in its early stages, it suggests that intentional personality change is possible. However, it is important to note that the long-term effects on personality remain unclear at this stage.

Further, as the intervention includes cognitive and behavioral components, it is in line with cognitive behavioral therapy (CBT) techniques for treating anxiety. CBT approaches are widely regarded as the most

efficacious and reliable treatments for anxiety disorders (*e.g* [26-28]. CBT includes several components that are analogous to aspects in the Dharma Life Sciences Program. Psychoeducation is key, which involves providing clients with information about their symptoms, the nature of their problems, and the principles of the treatment. Cognitive restructuring involves identifying and challenging maladaptive thoughts and beliefs that contribute to emotional distress or problematic behaviors. Behavioral components include increasing engagement in rewarding or meaningful activities to counteract symptoms of depression or other emotional disorders. Exposure techniques can be used, which involve gradually confronting feared situations or stimuli in a safe and controlled manner, allowing them to learn that their anxiety decreases over time without engaging in avoidance behaviors. Homework is a significant part of CBT, including practicing skills or implementing strategies learned in therapy sessions in real-life situations.

1.3. Overview of Intervention

The Dharma Life Sciences program involves an eight-week intervention that aims to help individuals with maladaptive personality traits. This program relies on two smartphone applications (Discover Personality and Enhance Personality) and weekly telephone sessions with a Dharma Life Sciences Mentor. First, the participant and mentor use the Discover Personality App to identify a personality trait that is potentially maladaptive. In this case, the trait is identified as potentially contributing to the participant's difficulties with anxiety. Next, the participant is instructed by their mentor about how to use the Enhance Personality App. This app creates a simulated learning environment and guides users in performing actions that counteract the cognitive biases associated with their identified traits. These actions are categorized into Brain Actions, Mind Actions, and Real-World Actions.

1.4. Brain Actions

The first category of actions is the *Brain Actions*. These activities encompass games aimed at addressing cognitive processes associated with one's personality trait and are highly similar to cognitive bias modification strategies used in CBT [29]. For instance, in the "fact-full" brain action, a scenario is presented along with three to four facts. Participants are then asked a question related to both the scenario and the facts. The facts are strategically chosen to encourage an automatic response that goes against the user's current trait. Users are guided to select an answer based on a broader understanding of the situation, focusing on the quantity of facts that support a particular response rather than being influenced by a single trait-related fact. To maintain balance, some answers may align with responses typical of an individual's trait.

1.5. Mind Actions

Mind actions are hypothesized to play a crucial role in behavior change by fostering a transformation in how an individual perceives their past experiences. They encourage individuals to engage in reflective practices, prompting them to revisit events that occurred during their day or throughout their lives. Aligning with ideas central to narrative therapies [30], this introspection is thought to be vital because it allows individuals to reframe and reinterpret past events, thereby altering the significance they attach to them.

Furthermore, mind actions are designed to empower individuals to develop more informed and deliberate decision-making strategies. By regularly reflecting, individuals may enhance their capacity for conscious decision-making. For instance, journaling, one of these mind actions, enables individuals to chronicle their thoughts and feelings, potentially providing a deeper understanding of their experiences. Likewise, alternative thinking could prompt individuals to explore alternative viewpoints and responses to situations, offering them a broader perspective when making choices.

Incorporating mind actions into one's daily routine may be instrumental in effecting behavior change. These actions may encourage self-awareness, the reevaluation of past experiences, and the development of more effective decision-making skills. Ultimately, they aim to contribute to an individual's personal growth and enable them to navigate life's challenges with greater resilience and adaptability.

1.6. Real-world Actions

The last category of actions is the *Real-World Actions*. Real-world actions draw inspiration from exposure therapies [31], where users actively engage with situations they tend to avoid or that may trigger their maladaptive trait. This includes activities like observing individuals in their daily lives who exhibit behaviors they aim to emulate. Some of these actions can be customized collaboratively by the mentor and the participant. For instance, in the program's later stages, participants are encouraged to brainstorm and execute real-world actions that challenge their typical behavior.

Furthermore, the app features a "trait scale" ranging from zero to a hundred, offering users a visual representation of their progress throughout the program. This scale serves as a tool for users to track and communicate their advancements with their mentors. To share their action-related data, the app includes a log report generator that consolidates their progress into a single document. Participants send this report to their mentor on a weekly basis, providing an overview of their achievements. This facilitates meaningful discussions between the participant and mentor about the actions taken and their impact on the participant's journey toward personal growth and change.

1.7. Mentor Sessions

The mentor employs a Report Analyzer to assess the participant's weekly log report (which is generated by the Enhance Personality app) and monitor their development throughout the program. This tool compiles data derived from the participant's log, which is submitted to the

mentor before each weekly session. It transforms this information into a format that allows the mentor to delve into the specifics of the participant's actions. For instance, in the case of brain actions, the data would reveal areas where the participant faced challenges in their gameplay and highlight their areas of success. Based on the findings from each weekly report, the mentor shapes the agenda for the subsequent session, with the exception of the initial two discovery sessions.

1.8. Overview of Study and Hypotheses

In the current study, we tested whether the Dharma Life Sciences Program reduced self-reported anxiety symptoms among individuals who exhibit moderate to severe anxiety levels. We predicted that that the effect of the program on anxiety in the intervention condition would be stronger than the effect of a no-treatment control condition on anxiety.

2. MATERIALS AND METHODS

2.1. Ethics Statement and Reporting

All materials and methods received ethical approval from the Advarra IRB, Pro00054638. We followed the Helsinki Declaration for involving human subjects. All participants provided digital informed consent. We used the CONSORT checklist when writing our report [32].

2.2. Participants

We recruited participants through targeted ads on social media platforms such as Facebook and Instagram. To be included, participants had to report experiencing anxiety symptoms, be 18 years of age or older, and be comfortable using smartphone apps. They additionally had to have scores indicating moderate to severe anxiety levels in accordance with the Beck Anxiety Inventory (BAI [33]; (scores on the BAI > 22 indicate at least moderate anxiety) and the General Anxiety Disorder 7 (GAD-7 [34]; (scores on > 10 indicate at least moderate anxiety). We excluded participants experiencing any of the following self-reported behaviors in the past 6 months: substance abuse, self-harm, harm or destruction of another person or their property, suicidal ideations, and feeling helpless after the death of a loved one. This exclusion criteria ruled out populations that were the most vulnerable.

Seventy-three people were officially enrolled in the study. In the intervention group, one was considered enrolled if they qualified for the study and completed the first session of the program. Out of 73 enrollments, 30 were randomly assigned by the second author using a computer-generated random number generator to the control group and 43 were randomly assigned to the intervention group. Participants were blind to their condition. In the control group, 23 out of 30 participants completed the post-test. Only responses from 23 people were included in the analysis (23% dropout rate). In the intervention group, 20 out of 43 people completed the entire 8 sessions of the program. Only the responses of the 20 were included in the analysis (53% drop-out rate). We had originally planned to collect data from 25 participants

in each condition to give us high power (.90) to detect moderate effect sizes (f^2 = .25) for the between-within interaction in multiple regressions. Our achieved sample size gave us .89 power to detect between-within interactions of moderate effect size (Fig. **1**).

Of the 43 people in the study, there were 39 females, 3 males, and one participant who identified as "other" enrolled in the study. Participants identified themselves as White (67%), Asian (12%), Black (7%), Native American (2%) and Other (12%). Age groups were coded as 1 (18-20; 9%), 2 (21-29; 32%), 3 (31-39; 23%), 4 (41-49; 11%), and 5 (50 +; 23%).

2.3. Study Design

We conducted a randomized control trial consisting of the personality intervention group, which underwent our personality intervention, and the control group, which did not. After responding to the ad, both groups were assigned a web-based prescreen questionnaire *via* Typeform. Participants were prescreened using the BAI and GAD-7 to assess the severity of their anxiety symptoms at baseline. Those in the control group were not given specific instructions and were recontacted at the end of the 8 weeks to retake the BAI and GAD-7. Participants in the personality intervention group were contacted by a Dharma Life Mentor to schedule their first session once they submitted their pretest assessment. Qualifications for Dharma Life Mentors included having at least a Bachelor's degree from an accredited institution in psychology. For the next 8-weeks, participants completed the intervention and took the BAI and GAD-7 within a week of completing the program.

A no-treatment control group allowed us to determine whether the novel intervention produced meaningful effects beyond natural fluctuations. We are therefore able to establish the efficacy of the intervention and discern whether it produces benefits beyond the absence of treatment, non-specific factors, and the passage of time. This helps ensure that any observed benefits are attributable to the intervention itself rather than external variables. Utilizing a no-treatment control group is also more cost-effective compared to employing an active treatment control group, as it eliminates the need for additional resources and logistical considerations associated with administering an alternative treatment. This allowed us to allocate resources more efficiently while still obtaining valuable data on the intervention's efficacy. We considered the no-treatment control desirable at this initial stage of evaluating the efficacy of the Dharma Life Sciences program, however, we elaborate on the potential drawbacks of this design in the Limitations section.

2.4. Measures

The Beck Anxiety Inventory is a self-report measure that assesses the severity of anxiety symptoms in the past month [33]. It is a 21-item scale designed for adults ages 17-80. The scale rates the frequency at which one is bothered by anxiety symptoms ranging from 0 (*Not at all*)

CONSORT 2010 Flow Diagram

Enrollment

Assessed for eligibility (n=73)

Excluded (n= 0)
- Not meeting inclusion criteria (n=0)
- Declined to participate (n=0)
- Other reasons (n=0)

Randomized (n=73)

Allocation

Allocated to intervention (n= 43)
- Received allocated intervention (n= 43)
- Did not receive allocated intervention (n=0)

Allocated to control condition (n=30)
- Received control condition (n=30)
- Did not receive control condition (n=0)

Follow-Up

Lost to follow-up (n=0)

Discontinued intervention (opted out) (n=23)

Lost to follow-up (n=0)

Discontinued control condition (opted out) (n=7)

Analysis

Analysed (n=20)
- Excluded from analysis (n=0)

Analysed (n=23)
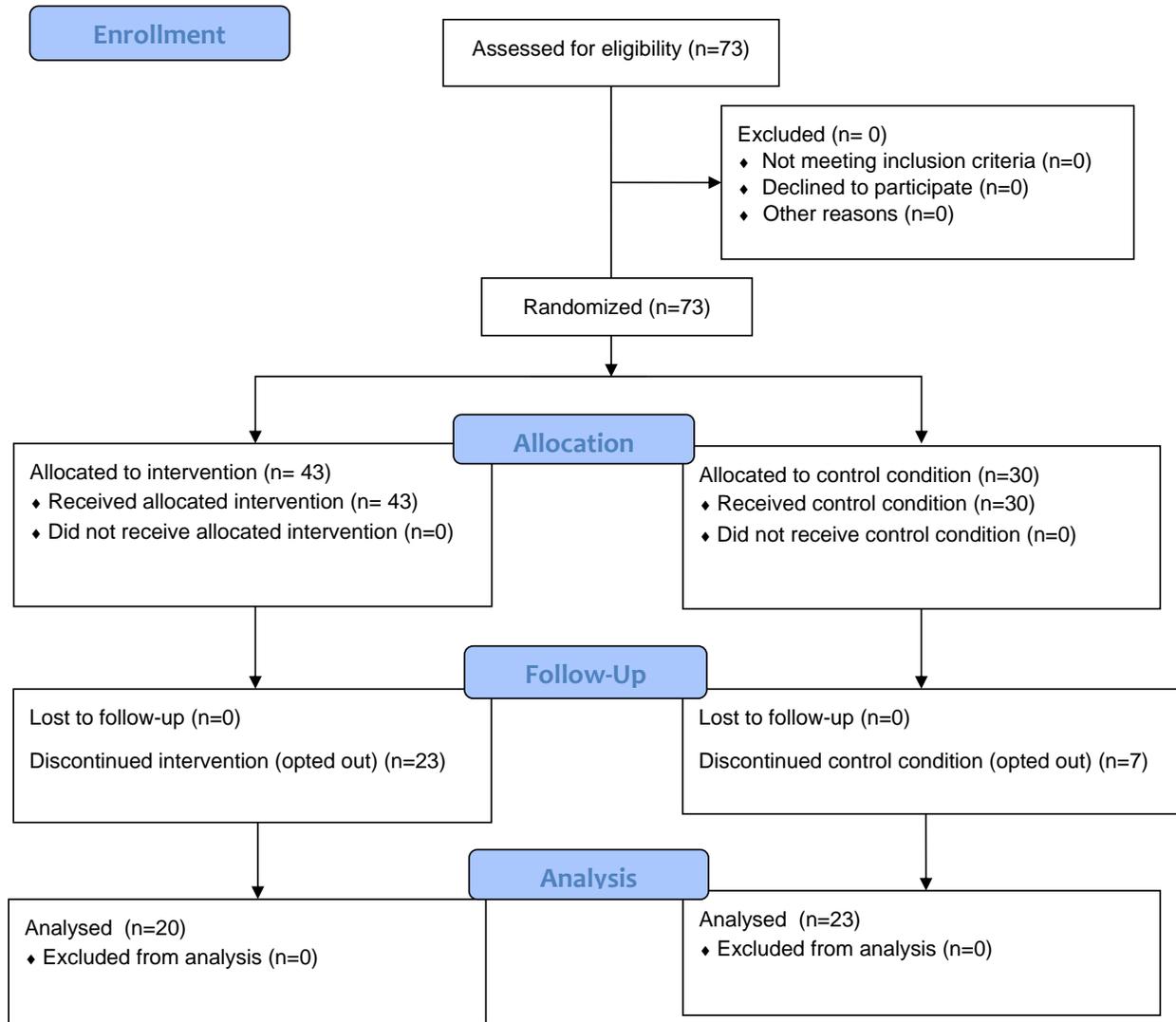- Excluded from analysis (n=0)

Fig. (1). CONSORT flow diagram.

to 3 (*Severely bothered me a lot*), with higher scores indicating more severe and frequent anxiety symptoms. The symptoms include, but are not limited to "Unable to relax," "Heart pounding/racing," and "fear of losing control." A summation of item scores indicates the severity of their anxiety symptoms with 0-21(low anxiety), 22-35 (moderate anxiety) and 36 and up (severe anxiety). We used this measure to prescreen participants, including only those who had scores indicating moderate to severe anxiety symptoms. The measure has high levels of internal consistency and concurrent and discriminant validity [33].

The GAD-7 is a 7-item self-report questionnaire that

was originally used to test for Generalized Anxiety Disorder [34]. The GAD-7 has also worked well as a screen for anxiety disorder symptoms [35]. The frequency of anxiety symptoms in the past two weeks can range from 0 (*Not at all*) to 3 (*Nearly every day*), with higher scores indicating more frequent symptoms. For this study, we omitted the latter portion of the GAD-7, which asks how difficult the symptoms have made it to operate socially, at work, or home.

Dharma Trait Questionnaires screen for potentially maladaptive personality traits. Mentors assign question-naires flexibly based on the initial session with the

participant (see the Supplemental Materials for a list of traits and measures). In this study, participants in the intervention condition were assigned questionnaires assessing the following traits: anxiousness (n = 8 participants); sensitivity (n = 4); perfectionism (n = 3); confidence (n = 3); empathy (n = 1). Participants completed the assigned measures in the Discover Personality App. See the Supplemental Materials for trait scores at baseline and follow-up for participants completing the intervention (low ns in subgroups prevent inferential statistics at the subgroup level).

2.5. Intervention Design

The goal of the first two sessions is to identify and assess the trait that will be the focus of the intervention. These sessions involve consultation with the Dharma Life mentor, completing trait questionnaires using the Discover Personality app, and reviewing results jointly with the mentor. Sessions three through eight constitute the intervention stage, wherein the participant works with the app and mentor to modify the trait identified in sessions one and two.

2.5.1. Session 1

The purpose of this session is gathering information to assess problematic personality. In the first session, the mentor gathered information about the participant's personality traits using interview questions. Sessions began with the question "If there is one aspect of your behavior you'd really want to change, what would it be and why?" Mentors asked follow-up questions to identify potentially problematic traits (see the Supplemental Materials for a list of traits and measures). For a maladaptive trait to be present, the participant must indicate consistent patterns of thoughts, feelings, and behaviors aligned with the trait and that anxiety is related to these patterns. The mentor and participant mutually agree regarding the potentially problematic trait(s). At the end of the session, mentors instruct the participants to install the Discover Personality app and assign them follow-up trait questionnaires in the app to serve as a secondary assessment for the trait(s).

2.5.2. Session 2

The purpose of this session is to further assess problematic personality and instruct the participant on how to use the Enhance Personality App. In Session 2, the focus remained on identifying the primary personality trait. The session began by revisiting the traits discussed in the previous meeting to ensure their accuracy. During this session, the mentor and participant discussed various aspects, including the participant's stated goals, observed patterns, and the participant's initial impressions based on follow-up questionnaires. The mentor, having already reviewed the questionnaire results, noted any traits confirmed by the trait scores and identified any new traits that may not have been evident in the first session. Each maladaptive trait was thoroughly explained, covering its definition, manifestations, and influence on the participant's perceptual biases. Together, the participant

and mentor confirmed the presence of all relevant traits. To determine the primary trait, participants were asked to recall the approximate onset of each trait, selecting the one with the earliest occurrence as the primary trait. This primary trait was then integrated into the Enhance Personality App. Participants were introduced to the app's sections - "Info," "Rewiring Statement," and "Actions" - and guided to complete the "Brain Actions" labeled as RW1 in the app. Additionally, they were instructed on how to submit the progress report before the next scheduled session.

2.5.3. Session 3

The purpose of this session is to review the participant's progress on "Brain Actions" and introduce "Mind Actions." At the beginning of this session, as with each subsequent session, the mentor inquired about how the participant felt about the challenges for the week. Prior to the session, the mentor reviewed the participant's game performance *via* Report Analyzer. Any incorrect answers on the games were brought to the participant's attention, for which the participant and mentor went over the rationale for the correct answers. Through discussion, mentors gauged the extent to which participants understood the rewiring statement and its applicability to the simulated scenarios in the "Mind Actions." Then, the mentor introduced the second rewiring statement. Participants were then shown the first "Mind Action" labeled Journal and were told how "Mind Actions" contribute to the improvement of their trait. They were then given examples of trait-relevant triggers that can occur. Towards the end of the session, the mentor sent the participant an email assigning "Brain Actions" labeled RW2 and the Journal feature under "Mind Actions."

2.5.4. Session 4

The purpose of this session is to review the participant's progress with their "Mind Actions" and "Brain Actions" assignments and to introduce the next set of assignments. Prior to the 4th session, the mentor reviewed the participant's journal entries in the Report Analyzer. Together, they went over any new questions where there were incorrect answers. Once the participant grasped how to apply the second rewiring statement in the "Mind Actions", the mentor and the participant moved on to new journal entries. The participant was asked to give a description of the triggers they reported for the week. Mentors detailed how the participant's trait might bias their interpretations of the trigger and instructed them to consider factors related to the rewiring statement that may reframe their perception of the scenario. New "Mind Actions" were assigned for the week in addition to the previous "Brain Actions."

2.5.5. Session 5

The purpose of this session is to explore how the participant coped with triggers and to identify "Real World Actions" for the coming week. Between the 4th and 5th sessions, the participant sent a report with their completed "Mind Actions." The session began with a

reflection on their past week's activities. Afterwards, the mentor asked them to detail their triggers for the week, and more specifically, how considering the rewiring reshaped their perception of the trigger. This was done to help participants consider ways they could adjust their perceptions should the trigger present again. The participant was introduced to the first set of "Real World Actions." The participant was encouraged to identify which challenges they'd like to attempt and keep note of these behavioral prompts in "Reflect." They were then instructed to use "Record" to detail what happened when the challenge was complete. Moving forward, participants were assigned easy challenges for the week, in addition to the "Mind Actions" and "Brain Actions."

2.5.6. Session 6

The purpose of this session is to identify challenges and successes over the previous week, as well as to introduce the next set of "Real World Actions" for the coming week. At the beginning of the session, the mentor asked the participants to reflect on their experience after completing the easy-level challenges. The mentor asked the participants to think about how they define success with the challenges. In instances where they felt less successful with the challenges, the mentor identified ways that the participant might be able to alter both their perspective and performance for the next challenge. The mentor then highlighted how the shifting perspective could promote the successful completion of the challenge. Subsequent conversations for this session covered any "Mind Actions" that were completed this week. However, priority was given to discussing the "Real World Actions." Towards the end of the session, the mentor assigned participant intermediate-level challenges to complete for the coming week in addition to the previous assignments.

2.5.7. Session 7

The purpose of this session focused on discussion on challenges and successes, assignments for the coming week, and instructions about the posttest questionnaires. Much like session six, session seven gave priority to the discussion of the outcome of the intermediate-level challenges. After the participant detailed their experiences with the challenges and triggers for the week, the mentor assigned the posttest Trait Questionnaires in the Discover Personality app. The mentor suggested the participant take the questionnaires towards the end of the upcoming week once activities were completed. Participants were also told to finish up their behavioral challenges for the week by completing challenging level "Real World Actions" in addition to the "Brain Actions" and "Mind Actions"

2.5.8. Session 8

The purpose of this session was to review the successes and challenges of the previous week and to reflect on the program overall. Prior to the 8th session, the participant sent the mentor their final report and their post-test assessment. The mentor began the session by asking about the final set of "Real World Actions." Following discussion, the mentor then prompted the participant to reflect on the program overall. For instance, mentors may ask them to consider what changes they noticed now that the 8-week program is complete. The mentor revealed the results of their post-test assessment from the app and congratulated the participant on their completion. Lastly, the mentor assigned the participant the GAD-7 and BAI for the posttest.

2.6. Data Analyses

Mixed-model analysis of covariance (ANCOVA) was our primary analytic strategy. It was used to test within-subject differences across time, between-condition differences at each time point, and the condition × time interaction effect. These analyses were conducted with each of the completed measures while statistically controlling for age. The within-subject difference across time for the intervention group tests the hypothesis that people in the intervention will show reduced anxiety over time. The condition x time interaction effect tests the hypothesis that people in the intervention condition will show greater reductions in anxiety over time than those in the control condition.

The within-subjects factor was time, with two-time points for participant ratings. Mauchly's test of sphericity was applied to ANCOVAs. The between-subjects factor was condition (*i.e.*, control or intervention). Bonferroni-corrected pairwise comparisons were examined to determine at which time points the significant differences, if any, occurred.

Table 1. Outcome measures across condition and time.

Variable	Control Group Mean (SD)	Intervention Group Mean (SD)	Within-Group Effect (F, η^2_p, Cohen's f)	Between-Group Effect (F, η^2_p, Cohen's f)	Interaction Effect (F, η^2_p, Cohen's f)
BAI	-	-	20.65***, .34, .72	1.39, .03, .18	6.25*, .14, .40
T1	31.09 (5.33)	31.10 (7.34)	-	-	-
T2	21.17 (7.33)	15.05 (8.80)	-	-	-
GAD7	-	-	7.82**, .16, .44	.69, .02, .14	20.13**, .34, .72
T1	13.78 (3.10)	15.90 (2.69)	-	-	-
T2	11.74 (5.02)	7.55 (4.91)	-	-	-

Note: *p < .05, **p < .01, ***p < .001 For η^2_p: small = 0.02, moderate = 0.15, large = 0.35. For Cohen's *f*: small = 0.10, moderate = 0.25, large = 0.40.

Given the relatively small sample size, effect sizes were calculated using partial eta-squared estimates (included in Table **1**). We also reported *Cohen's F* for the ANCOVA results. For *partial eta squared*, 0.02 is indicative of a small effect, 0.15 is considered a medium effect, and 0.35 is indicative of a large effect; for *Cohen's F*, 0.10 is indicative of a small effect, 0.25 is considered a medium effect, and 0.40 is indicative of a large effect [36].

3. RESULTS

We present results for the BAI and GAD-7 below (see Table **1** for the relevant statistics from the mixed ANCOVA controlling for age).

3.1. BAI

Mauchly's test indicated that the assumption of sphericity was met exactly. The mixed ANCOVA showed that the main effect of age was not statistically significant ($F_{(1,40)} = 3.40$, $\eta^2_p = .08$, $p = .07$). The between-group effect of condition was not significant, but the within-group effect of time was significant. These results were qualified by a significant interaction between condition and time, indicating that the within-group effect depended upon the condition. Therefore, we conducted follow-up pairwise comparisons within groups and between groups.

The within-group effects across time were significant for both the control group ($F_{(1,40)} = 29.12$, $\eta^2_p = .42$, $p < .001$) and the intervention group ($F_{(1,40)} = 72.18$, $\eta^2_p = .64$, $p < .001$). The between-group difference at T1 was not

significant ($p = .54$). The intervention group mean was lower than the control group mean at T2 ($p = 04$). In sum, these results indicate that both groups showed decreases in the BAI over time and that the intervention group showed a larger decrease, supporting hypotheses. See Fig. (**2**) for a graphical depiction of these results.

Mauchly's test indicated that the assumption of sphericity was met exactly. The main effect of age did not show a statistical effect ($F_{(1,40)} = .35$, $\eta^2_p = .00$, $p = .70$). The between-group effect of condition was not significant, but the within-group effect of time was significant. These results were qualified by a significant interaction between condition and time, indicating that the within-group effect depended upon the condition. Therefore, we conducted follow-up pairwise comparisons within groups and between groups.

3.2. BAI by Condition and Time

The within-group effects across time were significant for both the control group ($F_{(1,40)} = 4.96$, $\eta^2_p = .11$, $p < .05$) and the intervention group ($F_{(1,40)} = 69.08$, $\eta^2_p = .63$, $p < .001$). The control group mean was lower than the intervention group mean at T1 ($p = .02$), but the intervention group mean was lower than the control group mean at T2 ($p = 02$). In sum, these results indicate that both groups showed decreases in the GAD-7 over time and that the intervention group showed a larger decrease, supporting hypotheses. See Fig. (**3**) for a graphical depiction of these results.
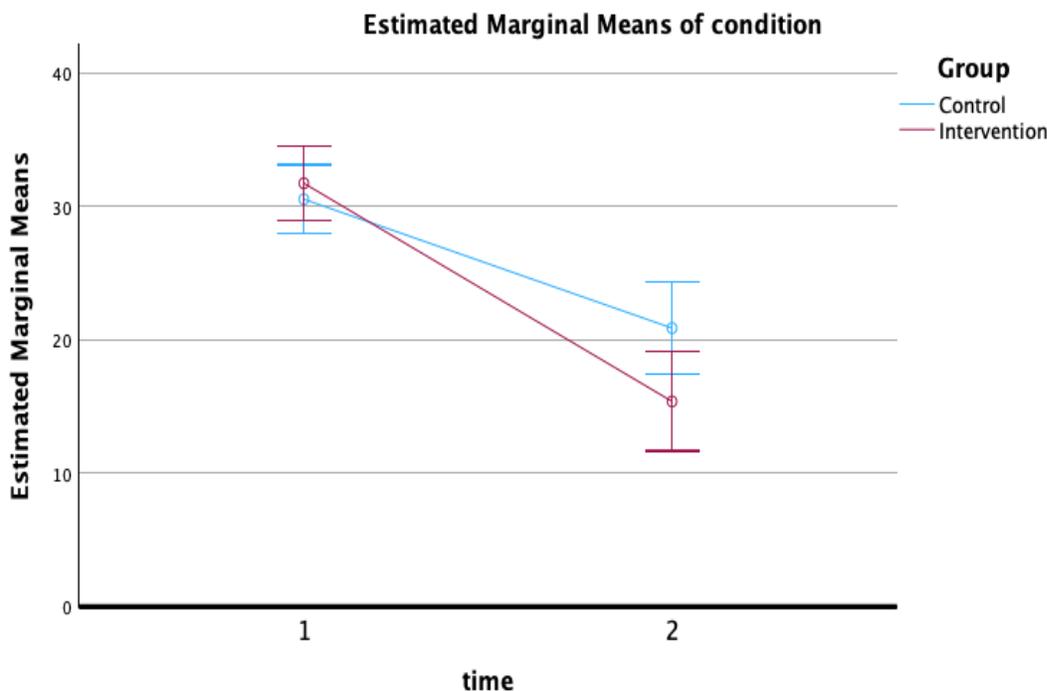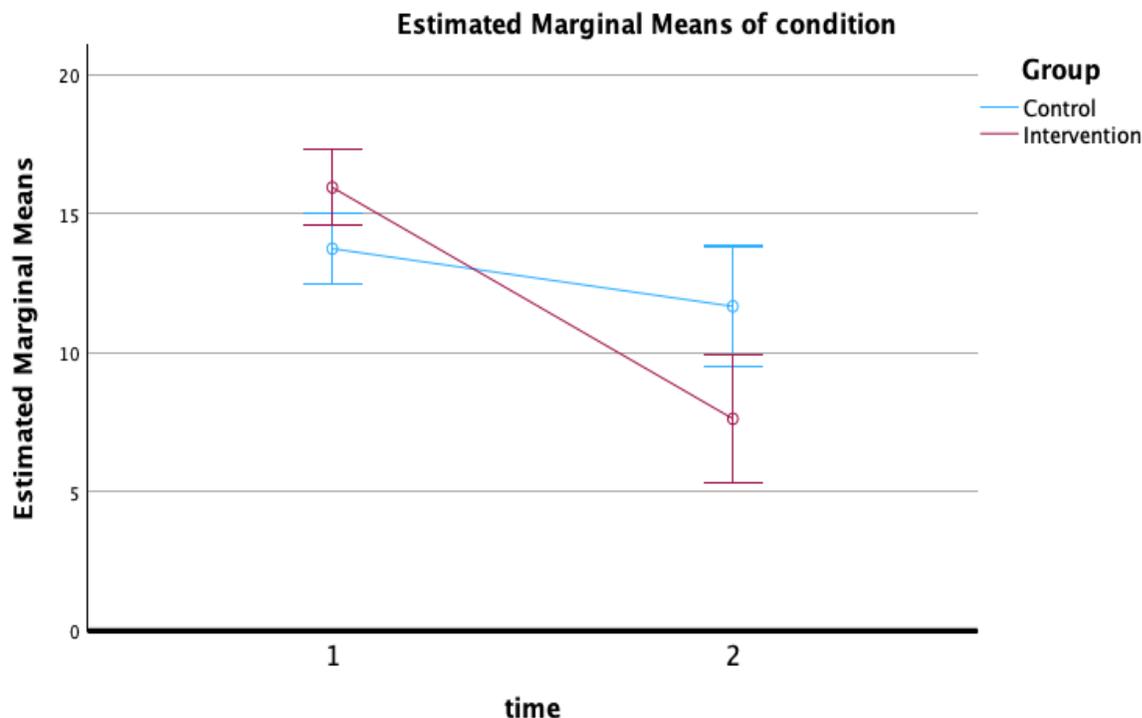

Fig. (2). BAI by condition and time.

Fig. (3). GAD7 by condition and time.

4. DISCUSSION

This study examined the impact of Dharma Life Program's eight-week intervention on anxiety levels for individuals with moderate to severe levels of anxiety. The program is based on the idea that personality may underlie anxiety [1-4], and thus addressing personality factors that contribute to anxiety may reduce anxiety levels. Further, the program is designed to target cognitive biases associated with personality traits that underlie anxiety based on the idea that such biases maintain anxiety [9-11]. We predicted the anxiety levels would decline among those in the program, and we predicted significant anxiety reduction in the intervention group compared to the control group. Anxiety levels declined for both the control and intervention groups, and the intervention group declined significantly more over time—supporting both of our hypotheses. Further, hypotheses were supported by two reliable and valid measures, the BAI and GAD-7. The effect sizes were large, suggesting that this intervention may be a promising and practical mechanism for anxiety reduction.

There is also evidence that the Dharma Life program improves emotional competencies such as emotional self-awareness, adaptability, and positive outlook among a non-clinical population [8]. We therefore have reason to believe that this intervention holds promise as a more general vehicle by which individuals may attain self-improvement goals. We believe that the next step for research is to determine the long-term impact of the program, perhaps by following up with participants weeks to months after completion to determine if the effects are durable and long-lasting.

This study builds on research that suggests people may voluntarily change aspects of their personality (*e.g* [20-22], including features of traits associated with anxiety. Further, our findings bridge the gap between literature on interventions for personality change and anxiety reduction through modifying cognitive biases (*e.g.*, [9. 11]. The study suggests a potential integration of personality theory, which focuses on stable individual differences, with cognitive theory, which examines thought patterns and biases. By targeting personality traits associated with cognitive biases underlying anxiety, the intervention bridges these two theoretical perspectives, providing a more comprehensive understanding of anxiety etiology and treatment.

Based on these findings, we can speculate that personality change, through voluntary means, may be an approach to anxiety reduction worth exploring further. This may be a particularly important topic of inquiry because research has demonstrated longitudinal links between personality and anxiety disorders [2, 4, 7]. By targeting personality traits associated with cognitive biases, the intervention may have the potential to produce long-term benefits in anxiety management. Addressing underlying vulnerabilities at the personality level may lead to more enduring changes in cognitive processing and coping strategies, reducing the likelihood of anxiety

recurrence over time. However, it is important to note the caveat that we do not yet have empirical data bearing on the long-term effects of this intervention or other short-term personality interventions [20-23, 25], and therefore the potential for long-term benefits awaits further research.

Future work may also seek to confirm that the proposed mechanism of action, the reduction of cognitive biases associated with particular traits, is responsible for the reduction in anxiety. By addressing underlying vulnerabilities, the intervention may effectively disrupt the cognitive patterns that contribute to anxiety, offering a novel avenue for intervention beyond traditional symptom-focused approaches. The findings highlight the potential for personalized interventions tailored to individuals' specific personality profiles and cognitive vulnerabilities. By targeting these factors, interventions can be more precisely tailored to address the underlying mechanisms driving anxiety, leading to more effective and efficient treatment outcomes.

4.1. Limitations

This study is subject to limitations that can be addressed in future studies. First, our sample size was relatively small. To improve the power of the study to detect relatively small effect sizes and obtain more reliable estimates of between-group differences, a larger sample size should be utilized. Another limitation related to sample size is that we could not compute inferential statistics on trait scores because subgroup sample sizes were too small, and therefore we encourage future research with larger sample sizes to pursue this direction.

A second limitation of our study includes the attrition of participants in the intervention group. It is possible the participants who remained in the study may have been inherently more motivated to continue.

Third, participants in the control group were not subject to restrictions during the eight weeks. It is plausible that the declines in anxiety among this group can be attributed to extraneous variables that occurred after the onset of this study. This may include new medications, changes in life circumstances, or self-initiated anxiety-reducing efforts. To control for this, a future design may offer a placebo instead. Relatedly, as it is not possible to completely blind participants to the condition, participants' potential knowledge of the condition may have biased outcomes. Future studies may apply assessment and statistical techniques to evaluate the contributions of incomplete blinding [37], however, there is not a clear consensus on how to do so, and there is little evidence that unblinding has consistent effects [38].

Fourth, because the intervention involved both the app and consulting with a mentor, we cannot isolate the potential effects of the app from the effects of the mentor. It is possible that one or the other was predominantly responsible for improvement in the intervention group. This study was intended to test the efficacy of the intervention as a whole, but future studies may attempt to test components of the intervention individually. One

potentially fruitful direction would be to measure cognitive biases directly to determine whether improvement in biases is responsible for improvement in anxiety.

Finally, our recruitment efforts allowed participants to voluntarily sign up for the study, potentially introducing self-selection biases. However, the participants reflected in the study are not the most representative sample given the size of the sample and their demographics. Future studies can utilize random sampling techniques to allow for a more representative sample, and therefore—more generalizable results. Notwithstanding this limitation, randomization to treatment and control groups serves as a safeguard against self-selection bias by minimizing the influence of participant characteristics or preferences on treatment assignment. This strengthens the internal validity of the study and allows us to draw causal inferences about the effects of the treatment.

CONCLUSION

In conclusion, our study set out to investigate the effectiveness of the Dharma Program in alleviating anxiety in individuals facing anxiety-related challenges. The outcomes have provided us with promising initial evidence that this intervention has the potential to effectively reduce anxiety. This sheds light on a compelling avenue of intervention that focuses on instigating personality changes by addressing and modifying cognitive biases. Such an approach holds promise for those grappling with anxiety-related difficulties. While these results are undoubtedly encouraging, the next steps in this research domain should delve deeper into the mechanisms through which these changes are occurring, ultimately broadening our understanding and refining our ability to help individuals combat anxiety and lead more fulfilling lives.

LIST OF ABBREVIATIONS

CBT	=	Cognitive Behavioral Therapy
BAI	=	Beck Anxiety Inventory
GAD-7	=	General Anxiety Disorder 7

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All materials and methods received ethical approval from the Advarra (IRB, Pro00054638).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

All participants provided digital informed consent.

STANDARDS OF REPORTING

CONSORT guidelines were followed.

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