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Engagement and Retention of College Students with Anxiety and Depressive Symptoms in a Digital Mental Health Intervention Using a Brief Peer Support Model

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Abstract

Digital mental health interventions (DMHIs) show promise in improving access to mental health care for college students suffering from depression and anxiety symptoms. Nonetheless, the usefulness of DMHIs is limited by high user attrition. Leveraging peer support among college populations may be a feasible and cost-effective option to improve DMHI engagement and improve mental health outcomes. This open pilot study evaluated the feasibility, acceptability, and initial efficacy of a skill-based peer support group in enhancing user engagement in a DMHI for depression and anxiety symptoms. Participants were 20 undergraduate students at a university in New Jersey with elevated depression and anxiety levels. Each week, they were asked to attend a peer support group and complete one to three modules of Therapy Assistance Online (TAO), a DMHI providing psychoeducation and coping strategies for depression and anxiety. Of the 233 students deemed eligible by the screening survey, 20 participants enrolled in the program and attended at least one group meeting. Nineteen participants completed at least 50% of the TAO modules, with an overall adherence rate of 87%. The average attendance rate of peer support groups was 83%. Participants were relatively satisfied with the program, and anxiety and depression symptoms significantly decreased from baseline to seven weeks. The integration of a peer support group fostered a sense of accountability and solidarity among participants, while also serving as a platform for addressing questions and sharing insights. Future research can focus on efforts to improve scalability of TAO with peer support by evaluating the feasibility of recruiting and training undergraduate students to assume the role of peer leaders for the support groups.

Keywords: anxiety, depression, digital interventions, peer support, college students

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Contents

Introduction

Depression and anxiety are the most prevalent psychological disorders among college students in the United States (U.S.) (Auerbach et al., 2016; Gorman et al., 2020). Surveys have indicated high rates of depression and anxiety among U.S. college students (Acharya et al., 2018b; Casey et al., 2022), with prevalence rates having increased in the previous decade (Lipson et al., 2019) and since the start of the COVID-19 pandemic (Son et al., 2020). Furthermore, psychological symptoms have been associated with severe functional impairment among university students. These include difficulties in social life and interpersonal relationships, poorer academic outcomes (e.g., lower GPA, higher dropout rates), lower occupational attainment, and greater risk of suicidal attempts and deaths (Alonso et al., 2018; Eskin et al., 2016; Hjorth et al., 2016; Slominski et al., 2011). Suicide is the second leading cause of death among those aged 15 to 24 (Hedegaard et al., 2021) and university students in the U.S. (Turner et al., 2013), and even college students exhibiting subclinical depressive symptoms are at risk for experiencing suicidal ideation (Cukrowicz et al., 2011). This indicates a need for early intervention and expanded access to mental health services among this population.

Despite the high prevalence of depression and anxiety, most students do not seek mental health services (Blanco et al., 2008; Lipson et al., 2018). Only 25% of students reported intentions to seek psychological treatment for future emotional problems, with more than half of students reporting a preference to manage mental health problems on their own (Ebert et al., 2019; Lipson et al., 2018). A study examining college students with elevated depression found that the most frequently endorsed barriers to professional help-seeking were beliefs that treatment is unnecessary due to their problems being minor or temporary (66%), time constraints (27%), and a preference for self-help techniques (18%) (Czyz et al., 2013). Among students who

do seek psychological treatment, most receive services on campus (Lipson et al., 2019). However, mental health services on college campuses have significant limitations, such as long waitlists and time-limited treatment (Gallagher, 2014; Reetz et al., 2016). As demands for psychological services have increased, college counseling centers have struggled to meet the rising need for mental health services (Cornish et al., 2017). Counselors have reported issues with burnout while maintaining large, challenging caseloads (Sim et al., 2016). In addition, the COVID-19 pandemic has further exacerbated the preexisting mental health crisis among college students (Son et al., 2020).

Digital mental health interventions (DMHIs), also known as online interventions, internet-based interventions, or mental health applications (MHA), offer a potential solution to address the growing mental health needs of college students. DMHIs generally consist of psychoeducation, skill-focused content, and self-monitoring tools to manage psychological symptoms. DMHIs overcome logistical (e.g., expenses, scheduling) and attitudinal barriers (e.g., perceived stigma, preference for self-help) to traditional mental healthcare through Web-based and computer-based platforms and mobile applications. Some DMHIs are completely self-guided, while others are enhanced by the guidance of a coach or therapist (Saddichha et al., 2014). These interventions can reach large numbers of individuals while providing other benefits such as lower costs, 24/7 access, reduced stigma due to anonymity, and increased timeliness of information (Chan et al., 2016; Griffiths et al., 2006). Additionally, DMHIs have been found to significantly reduce depressive and anxiety symptoms and increase psychological well-being among college students (Farrer et al., 2013; Harrer et al., 2018; Lattie et al., 2019).

University students largely report positive attitudes towards the use of DMHIs and are open to using them, with some students reporting a stronger preference for DMHIs compared to

traditional services (Lungu & Sun, 2016; Ryan et al., 2010). Despite the high accessibility of DMHIs and favorable attitudes towards them, studies have generally found low engagement (Fleming et al., 2018). Engagement with DMHIs can be defined by several metrics: uptake (i.e., initial download and utilization), retention (i.e., continued use over time), adherence (i.e., consistent use at the intended frequency and duration), and completion (i.e., completion of all modules) (Fleming et al., 2018; Lipschitz et al., 2023). In a 2019 systematic review of DMHIs, few college students reported completing all available modules (Lattie et al., 2019). Additionally, a 2012 systematic review found an overall attrition rate of 57% across forty studies, with a particularly high dropout rate of 74% among unguided DMHIs (Richards & Richardson, 2012). Thus, the effectiveness of DMHI is clearly hindered by engagement issues. Given the lack of accessibility to traditional mental health treatment on college campuses and the efficacy of DMHIs in treating depression and anxiety among fully engaged users, it is crucial to identify feasible methods of increasing DMHI engagement and user retention.

Factors such as low motivation levels among users contribute to poor DMHI engagement among university students (Wilhelmsen et al., 2013). Research has shown that human support can significantly enhance engagement and retention in DMHI usage (Roddy et al., 2018), and incorporating peer support could foster accountability and motivation to complete treatment. Structured peer interventions among college students offer the potential for improving mental health outcomes in a population with unmet needs (Byrom, 2018; Fontana et al., 1999). Furthermore, given that students are frequently surrounded by their peers, college counseling centers could leverage this readily available and inexpensive resource.

There is limited research on the impact of peer interventions for improving engagement and retention in DMHIs, as well as in reducing anxiety and depressive symptoms among college

students. The purpose of the present study is to evaluate the feasibility, acceptability, and initial efficacy of a brief peer support group in increasing engagement and retention of an online intervention, Therapy Assistance Online (TAO), among college students with elevated anxiety and depression symptoms.

Literature Review

Mental Health among College Students

According to the National Center of Education Statistics (NCES), approximately 16.2 million students attended an undergraduate program at a college or university in the U.S. in Fall 2020 (National Center for Education Statistics, n.d.). Ninety-two percent of college students are under the age of 24 (Hanson, 2021), and approximately 70% of emerging adults (i.e., adults between the ages of 18 to 25) in the U.S. pursue post-secondary education (Arnett, 2016). This transition from late adolescence to emerging adulthood is a time of significant developmental change associated with identity exploration, vocational training, and novel social experiences (Arnett, 2000, 2016). Developmentally, the college years are also associated with amplified stress and mental health problems. A worldwide prevalence study found that most individuals experience the initial onset of mental health disorders by age 24 (Kessler et al., 2007). Higher education introduces unique stressors as well, including greater academic demands, financial challenges, interpersonal conflicts, and elevated anxiety and depression (Aselton, 2012; Kroshus et al., 2021). Many college students experience persistent mental health difficulties, with longitudinal research showing that 60% of college students with a mental health issue at baseline continued to report difficulties two years later (Zivin et al., 2009). Psychological difficulties have also been linked to negative outcomes in educational attainment, such as impaired academic performance (Bruffaerts et al., 2018; Eisenberg et al., 2009), and an increased likelihood of

dropout (Hjorth et al., 2016). Furthermore, those who reported a psychiatric disorder between the ages of 18 to 25 faced greater economic burdens later in adulthood, including reduced workforce participation and lower income at age 30 (Gibb et al., 2010). In severe cases, individuals who received inpatient treatment for a suicide attempt by age 30 were more likely to experience long-term unemployment or long-term disability pension compared to the general population (Niederkrotenthaler et al., 2014). Considering the enduring consequences of untreated mental health conditions on one's academic, occupational, physical and mental health, it is crucial to provide early intervention and access to treatment for undergraduate students.

DMHIs for Anxiety and Depression

Given the immense mental health burden among college students, DMHIs are one promising solution for increasing access to mental health resources. DMHIs have the potential to bridge gaps in traditional services, particularly for individuals affected by limited health insurance coverage and financial concerns (Rowan et al., 2013), scheduling conflicts, and time constraints (Czyz et al., 2013). Additionally, DMHIs offer a discreet and easily accessible option for mental health support, appealing to individuals who prioritize anonymity and convenience (Wallin et al., 2016). In fact, college students tend to report overall positive attitudes towards DMHIs for mental health treatment (Kern et al., 2018; Levin et al., 2018; Lungu & Sun, 2016; Ryan et al., 2010). Another benefit of DMHIs is their potential to alleviate the workload of mental health professionals. Research suggests that therapist-supported DMHIs can achieve comparable reductions in anxiety symptoms to traditional cognitive therapy while demanding far fewer therapist hours (Clark et al., 2023).

Research indicates that DMHIs can facilitate reductions in depression and anxiety symptoms (Farrer et al., 2013; Lattie et al., 2019; Saddichha et al., 2014). A systematic review

evaluated the efficacy of internet-based interventions for depression and anxiety (Saddichha et al., 2014), with most interventions employing a cognitive-behavioral therapy (CBT) approach. Among 29 studies, they found modest effect sizes (Cohen's d = 0.3-0.7) for self-guided online CBT interventions for depression and larger effect sizes (Cohen's d = 0.6-1.9) for therapist-guided online CBT interventions for depression. In 24 studies of DMHIs targeting anxiety symptoms, Saddichha et al. (2014) found large effects for both therapist-guided online CBT interventions (Cohen's d = 0.7-1.7) and self-guided online CBT interventions (Cohen's d = 0.6-1.7). Thus, there is evidence supporting the efficacy of CBT-based DMHIs for depression and anxiety.

Similar results have been observed in university populations. A systematic review of 89 studies focusing on college students examined the effectiveness and usability of DMHIs targeting depression, anxiety, psychological well-being, and/or stress (Lattie et al., 2019). Lattie et al. (2019) included studies of Web-based (n = 72), mobile phone applications (n = 8), offline computer-based programs (n = 11), and virtual reality programs (n = 3). The studies included various types of guidance and support, including human support (n = 33), automated support (n = 18), peer support (n = 2), unguided interventions (n = 33), and online treatment as an adjunct to in-person treatment or unclear support (n = 3). Most studies indicated improvements in all targeted psychological outcomes (42 out of 89 studies) or some targeted psychological outcomes (30 out of 89 studies). However, Lattie et al. (2019) did not examine whether outcomes differed depending on the level of human support. In sum, these findings suggest that when intervention adherence is high, DMHIs can be effective in treating depression and anxiety symptoms. However, the desired effects cannot occur if user engagement with these interventions is

minimal. A sufficient intervention dosage is necessary for therapeutic effects to become apparent.

Therapy Assistance Online (TAO)

Therapy Assistance Online (TAO) is an online platform designed to treat issues such as anxiety, depression, stress management, and other common stressors. TAO includes numerous modules containing interactive psychoeducational lessons, mindfulness exercises, progress logs and badges, text message reminders, daily homework, and resources for crises and emergencies. The modules incorporate evidence-based treatments, including Cognitive Behavioral Therapy (CBT), Behavioral Activation, and Acceptance and Commitment Therapy (ACT). TAO also offers modules designed to help students navigate stress, academic struggles, perfectionism, relationships and communication, and time management. To address the limited resources of school counseling centers, TAO has been adapted by several colleges and universities in the U.S.

Despite the widespread and growing utilization of TAO at counseling centers across the country, there is little research testing the effectiveness of TAO in engaging and treating college students with clinically significant depression and anxiety symptoms. Currently, there is one empirical, peer-reviewed article comparing the effectiveness of traditional therapy to a seven-week TAO treatment plan for anxiety (Benton et al., 2016). Conducted at a large university counseling center, this study evaluated anxiety and well-being outcomes between students who completed face-to-face individual psychotherapy and students who completed TAO. Benton et al. (2016) utilized a non-randomized design where students were allowed to choose their preferred treatment modality. While the initial findings are promising, there is also a dearth of research on user engagement and acceptability of TAO. Considering the widespread adaption of TAO by U.S. universities and colleges, this is an important area for future investigation.

Barriers to DMHI Engagement and Retention

Despite the convenient accessibility of DMHIs, few college students report using them. Findings from a sample of community college students indicate that while more than half (60%) of students are open to using a DMHI, only 3% of students with heighted psychological distress used online mental health services (Dunbar et al., 2018). Similarly, a study from a four-year university found that while two-thirds of students were reportedly open to using a Mental Health App (MHA), very few had used an MHA (8.1%) or other online interventions (4.5%) (Reyes-Portillo et al., 2022). In addition to low utilization, low engagement is another major limitation in treating depression and anxiety through online programs. DMHIs such as MoodGYM, CBTPsych, and Anxiety Online, which consist of approximately 5 to 7 modules, reported average completion rates ranging from 3 to 20% (Menzies et al., 2016; Neil et al., 2009). The effectiveness of DMHIs is considerably hindered by the low adherence to online treatment programs, as a 2021 meta-analysis found a significant relationship between greater DMHI engagement and post-intervention depression and anxiety symptoms (Gan et al., 2021). It is evident that to improve mental health outcomes among DMHI users, there first needs to be a greater emphasis on improving engagement and retention.

Engagement Strategies

Researchers have examined a variety of strategies to address the issue of engagement in DMHIs. Previously studied engagement strategies have included electronic notifications and human support. Electronic notifications, such as e-mail, text, and push notifications, digitally prompt users to complete modules and/or activities on the DMHI (Muench & Baumel, 2017). These methods have demonstrated some success, in that Bidargaddi et al. (2018) found that sending a push notification with a personalized message resulted in users being 4% more likely

to engage with the app within 24 hours. Relatedly, Meyerhoff et al. (2024) studied an interactive text messaging intervention for anxiety and depression in which automated messages encouraged users to reflect and implement evidence-based psychological strategies. User engagement was sustained across the eight-week intervention, as measured by participants responding to automated messages on 70% of study days. However, smartphone users also frequently ignore notifications, even when the notifications come from apps that are important to them (Fischer et al., 2011). College students have also expressed concerns regarding the perceived lack of empathy and compassion in DMHIs, noting that engaging with an automated program can feel insincere (Reyes-Portillo et al., in press). While electronic notifications can enhance DMHI engagement, these findings underscore the importance of addressing user preferences and concerns to optimize engagement.

Whereas unguided DMHIs have the advantages of being self-serviceable and less demanding on college counseling center staff, most studies on DMHIs for depression and/or anxiety include some form of contact and support from mental health professionals. Human support is often delivered in the form of phone calls or online chat messaging with professionals. Phone calls offer users the opportunity to receive technical assistance with the DMHI, ask questions about the online material, and briefly review their progress (Drozd et al., 2016; Goldin et al., 2019). It has been hypothesized that human support provides users with a supportive individual to hold them accountable to execute their goals. In fact, guided interventions have demonstrated superior reductions in symptom severity and greater engagement (i.e., the number of completed modules and completer rate) compared to self-guided interventions (Andersson & Cuijpers, 2009; Baumeister et al., 2014; Musiat et al., 2022). One study also found that the frequency of coaching calls influenced program retention and treatment outcomes (Roddy et al.,

2018). Still, some evidence indicates that human support through phone coaching is not significantly greater than less personalized forms of communication, such as e-mail prompts, in improving DMHI engagement (Levin et al., 2020). Furthermore, the scalability of DMHIs with professional human support is less than ideal as the availability of mental health professionals that can provide these services is typically very limited, especially at college counseling centers, where staff maintain full caseloads (Muñoz, 2017).

Incorporating a group component may be a more scalable approach to providing human support as an engagement strategy for DMHIs. Sigurðardóttir et al. (2022) investigated whether adding group sessions would increase treatment adherence, measured by the number of modules completed, among Icelandic university students completing an online CBT program for social anxiety. Participants were randomly assigned to one of three groups: an experimental group, a placebo group, or no additional group component. The experimental group attended three group psychoeducation sessions, during which the module content was reviewed in a slideshow presentation, and participants were instructed to complete the relevant modules before the sessions. Participants in the placebo condition attended three online group sessions of progression muscle relaxation exercises guided by a therapist. Interestingly, the placebo condition demonstrated the greatest compliance with module completion. However, the experimental condition was not designed to be a peer support group but rather a review to check participants' understanding of the skills and to allow them to ask questions. This suggests that the format of group sessions is an important factor in its effectiveness as an engagement strategy for DMHIs.

While including a therapist-assisted component seems to be a promising approach in increasing DMHI engagement, recruiting student peers may be a more feasible and cost-effective

option to ease the burden on mental health professionals. In studies by Day et al. (2013) and Harrer et al. (2018), undergraduate and graduate student volunteers were used to provide support, encouragement, and technical assistance to college students completing DMHIs through e-mail and phone communications, resulting in significant reductions in depression and anxiety symptoms compared to waitlist controls. Day et al. (2013) reported a completion rate of 61% for a program consisting of five modules, while Harrer et al. (2018) had a 72% module adherence rate (i.e., the overall percentage of modules completed by all participants) across seven modules. Research also indicates that interacting with peers while completing DMHIs can enhance self-management and allow users to exchange resources with one another (Switsers et al., 2018; Walsh et al., 2018). Additionally, DMHIs with more social connectedness between users demonstrate greater user engagement (Borghouts et al., 2021; Ho et al., 2016; Tomasino et al., 2017). In particular, Ho et al. (2016) found that the number of online comments exchanged between users was significantly correlated with the average time spent on the site per use session. Qualitative data from this study indicated that users wanted more opportunities to interact with and get to know other users, and a systematic review of 18 studies by Borghouts et al. (2021) found that engagement was enhanced through connecting with peers or professional support. However, these studies primarily focused on the effect of professional support, and the research on peer support mostly consisted of qualitative studies from focus groups (Borghouts et al., 2021). There is a dearth of empirical research demonstrating the effect of peer support on DMHI engagement.

Rather than focusing on professional support, Tomasino et al. (2017) examined the effect of online peer support features on engagement for an 8-week DMHI in older adults with depression. Participants in the individual internet intervention (III) received brief weekly

coaching calls to increase engagement, assist with technical issues, and answer questions, whereas participants in the internet intervention with peer support (II+PS) had an activity feed with the opportunity to "like" and comment on others' activity. Participants in both treatment groups demonstrated significant reductions in depression symptoms from pre- to post-treatment, whereas the waitlist control had no significant decrease in symptoms. There was no significant difference in the mean number of DMHI sessions completed between treatment groups. These findings suggest that peer support may be as effective in enhancing user engagement as professional coaching. The current research on peer support as an engagement strategy for college students completing DMHIs is promising but largely unexplored in empirical research.

Theoretical Basis of Peer Interventions

Many college students tend to seek informal support from their peers before turning to professional help for depression (Eisenberg et al., 2011; Lipson et al., 2018; Reavley et al., 2012). Moreover, students seem more willing to seek help from others rather than relying solely on themselves. Insights from a focus group involving college students revealed that 54% of participants favored seeking assistance from others, whereas only 13% preferred to handle their issues independently (Reyes-Portillo et al., in press). Formal peer interventions can serve to build support networks among those with affiliative experiences to exchange knowledge and encouragement for mutual benefit, with the added advantage of increasing social connection (Solomon, 2004). Although peer interventions lack the specialized training of healthcare professionals, their less formal nature can circumvent some barriers to help-seeking. Students who perceive professional help as unnecessary or unhelpful may prefer informal support from others of equal status, and evidence indicates that college students often benefit from receiving guidance from their peers. One of the leading theories conceptualizing the effect of social

support on psychological and physical well-being is the stress-buffering model (Cohen, 2004), which suggests that social support has a moderating effect on well-being and is protective against the negative outcomes that typically arise from stress. In fact, a study of student-led peer support services found that most users reported that peer support improved their well-being (89%), that the peer support provider understood their experiences (92%), and that they received useful information, including referrals to other resources (71%) (Suresh et al., 2021). Thus, it is expected that college students with elevated depression and anxiety symptoms would be open to peer interventions and would demonstrate improvements in mental well-being.

Peer Support

Peer support is defined as a system of providing and receiving help between equals with shared experiences and/or mental health conditions (Mead et al., 2001). Unlike typical relationships between patients and healthcare providers, these relationships are based on mutual understanding of one another's circumstances. Social support between peers may include sharing emotional support (e.g., reassurance, validation), instrumental support (e.g., material goods and services), informational support (e.g., advice, information), and appraisal support (e.g., feedback) (Solomon, 2004). Rather than falling into the roles of patients and experts as occurs in formal healthcare settings, peer support bridges individuals with affiliated experiences to support one another in moving toward their values (Mead et al., 2001). Peer interventions have long been used in the context of physical and mental health treatment, and health promotion and can take many forms as a supplement or replacement for formal treatment provided by healthcare professionals. As compared to a patient-therapist interaction, the genuineness and mutual understanding in peer support networks can lead to stronger connections and feelings of empathy.

Peer support can be particularly valuable for college students, who frequently report feelings of loneliness, a situation exacerbated during the peak of the COVID-19 pandemic (Lee et al., 2020). Despite having frequent social contact on campus, many students experience loneliness due to cognitive discrepancies between the desired quality of relationships and their actual experiences (Russell et al., 2012). These students may be more prone to depression and anxiety and are likely to drop out of treatment when using DMHIs due to the lack of accountability and support provided by human contact. College students with elevated depression and anxiety may have weak support networks and may need help finding a community of peers with shared experiences. Thus, the emotional, informational, and appraisal support offered by peer interventions can be particularly useful among college students, who often interact with their peers and have high prevalence rates of anxiety and depression (Auerbach et al., 2016; Gorman et al., 2020).

Social Impact Theory

Peers can provide much needed social support to college students who are vulnerable to depression and anxiety. The question is – why are *peers,* in particular, the appropriate individuals to provide this support? Social impact theory suggests that peers may be effective communicators in encouraging behavior change amongst their social circles. It has been proposed that altering an individual's health attitudes and behaviors is more likely if: 1) the source has similar characteristics and is seen as a credible source of information; 2) the source is close to the target in space and time; and 3) there are multiple sources communicating the attitudes and behaviors (Nowak et al., 1990). College peers share similar experiences as students and emerging adults, are close in proximity to one another at the university, and can receive health information from multiple sources given the large amount of college students on campus.

The phenomenon of learning more adaptive behaviors by observing and modeling the behaviors of others like oneself has also been proposed by social learning theory (Bandura, 1977). Furthermore, social comparison theory suggests that connecting with peers with shared mental health struggles can normalize help-seeking behaviors (Festinger, 1954). These theories suggest that college peers experiencing similar symptoms of depression and anxiety may be particularly relatable models of behavior change for others with psychiatric conditions due to their shared mental health background.

College students often learn adaptive health behaviors from one another, and the evidence supporting peers as effective communicators and role models has already been demonstrated by peer health education programs on college campuses. Peer health educators serve as role models and share information to enable other students to make informed choices regarding their health and well-being. Research has supported the role that peer health educators have in promoting healthy behaviors, such as responsible alcohol use and nutrition (White et al., 2009). Implementing a peer support model can potentially benefit students enrolled in a DMHI for depression and anxiety symptoms. College students can observe their peers applying coping skills to current stressors, receive advice and feedback from individuals with shared experiences, engage in mastery experiences, and receive encouragement and hope for success in completing the program and reducing their symptoms (Simoni et al., 2011). Therefore, peer support is a promising method for enhancing DMHI engagement and facilitating desired behavior changes.

Peer Delivered Self-Help

Peer support generally involves the sharing of emotional support, instrumental assistance, and/or informational support between individuals of similar experience or social position (Solomon, 2004). However, peer interventions vary broadly in terms of peer roles, conditions

treated, treatment modality (e.g., in-person, telephone, or online), and target population. Fortuna et al. (2022) identified multiple types of peer support services based on peer roles and organizational structure: 1) peer delivered self-help, 2) peer run services, 3) peer partnership, and 4) peers in recovery as employees. The present study focuses on peer delivered self-help, which is typically provided in group formats and is defined by informal and voluntary support between peers to achieve a mutual goal and/or cope with significant life stressors. Some peer delivered self-help groups have a trained or more experienced peer that provides unidirectional support or a skill-based program to group members (Byrom, 2018; Fontana et al., 1999). In some cases, peers may work side-by-side with traditional mental health professionals (i.e., non-peers) to facilitate the delivery of an intervention. Whereas mental health professionals possess the formal training in psychological treatment, peer facilitators can encourage participant engagement by modeling adaptive behavior (Muralidharan et al., 2021).

In contrast, peer run services include programs run by individuals with lived experience of psychiatric illness embedded within a formal organization with paid staff and volunteers (Solomon, 2004). Some examples of peer run services include warmlines providing information, referrals, and emotional support by peers (e.g., NAMI HelpLine) and psychoeducational programs focused on self-management of symptoms. Peer partnerships are service programs that share control of the operation of the program with non-peers (i.e., those without lived experience of mental illness). Lastly, peers in recovery as employees are those in designated peer or traditional mental health roles who publicly self-identify as a peer with lived experience of mental health (Solomon, 2004).

Peer delivered self-help groups are most appropriate in the college setting due to their informal nature and the ability to be facilitated by voluntary peers without professional mental

health training or affiliation with a formal organization. Given the high prevalence of depression and anxiety among college populations, it may be feasible to connect students with others who share similar mental health issues. In sum, peer delivered self-help groups (hereinafter referred to as *peer interventions*) bring together individuals with similar experiences and may be particularly valuable for college students with depression or anxiety, who may struggle to establish much-needed supportive social networks in this setting. Peers may also be the most appropriate individuals for encouraging behavior change due to their similar characteristics and shared experiences. Additionally, meeting with a peer can help overcome perceived stigma, a common barrier to seeking treatment (Levin et al., 2018). By seeing how their student peers with similar presenting problems have benefited from DMHI use and sharing their intentions with others in the program, college students may feel more motivated in continuing with their treatment plans.

Peer Interventions for Depression and Anxiety

In targeting physical health conditions, peer interventions have been used to help with weight loss, smoking cessation, improving HIV medication adherence, increasing safe sex behaviors, and coping with cancer (Campbell et al., 2008; Simoni et al., 2011; Sun et al., 2017; Ufholz, 2020; Ziegler et al., 2022). Peer interventions have also been used to support individuals afflicted with emotional and behavioral difficulties, including substance use and severe mental illness (Eddie et al., 2019; Fortuna et al., 2020; Fuhr et al., 2014). Peer support is an appealing treatment modality for depression and anxiety, given the wide prevalence of these conditions in the general population and among college students. A 2011 meta-analysis found that peer interventions demonstrated significantly greater reductions in depression symptoms compared to treatment as usual and was comparable to group cognitive behavioral therapy (Pfeiffer et al., 2011). The studies included in this meta-analysis involved peer support groups that met on a

weekly basis, ranging from one to nine months of meetings, while most held between 8 to 12 weekly sessions. The peer support groups focused on informational assistance, emotional support, problem-solving techniques, and exchanging feedback. The meetings were generally unstructured and non-directed, allocating between one to two hours for group members to share problems and elicit solutions and emotional support from others. Still, the generalizability of these findings is limited, such that several studies included in Pfeiffer et al. (2011) focused specifically on post-partum depression and individuals with chronic illness. The extent to which peer support influenced depression symptoms also remains unclear, as interventions led by mental health professionals were included in the meta-analysis as long as they included some level of peer engagement (Pfeiffer et al., 2011). No studies included college samples, and none included any psychoeducational components. In addition, the studies in the meta-analysis were conducted more than 15 years ago, reflecting a crucial need for updated research on peer interventions for depression.

Skill-based Peer Interventions

Skill-based peer interventions extend beyond emotional support by equipping participants with psychoeducational knowledge and techniques to identify and modify maladaptive cognitive and behavioral patterns. A meta-analysis of 23 studies (15 randomized controlled, 2 unrandomized controlled, and 6 uncontrolled) on peer interventions for depression found that educational/skill-based programs produced greater symptom reductions than primarily supportive peer interventions (Bryan & Arkowitz, 2015). Unlike the meta-analysis by Pfeiffer et al. (2011) which included peer support groups administered by a mental health professionals, Bryan and Arkowitz (2015) focused specifically on interventions administered by lay individuals with similar experiences to those being treated. Mental health professionals were limited to

secondary roles, such as training or providing supervision to the peer facilitator or as an occasional guest speaker.

Studies such as Byrom (2018) and Fontana et al. (1999) demonstrate the encouraging outcomes of skill-based peer-led interventions for depression and anxiety symptoms in college settings. An open trial by Byrom (2018) studied the effectiveness of a peer delivered self-help group provided for college students with anxiety or depression symptoms. The intervention was guided by a workbook on behavioral activation, and university students facilitated the peer support sessions. Group leaders were not required to have lived experience of depression, but those with experience of depression were encouraged to apply. Leaders completed a two-day training course in mental health, active listening skills, and motivational interviewing. They also received telephone-based supervision from recent university graduates with prior experiences of running peer support groups. The peer intervention implemented by Byrom (2018) included six weekly sessions structured around a workbook that focused on strategies for building and maintaining a positive mood. Peer support sessions included psychoeducational information, sharing emotional support by reflecting on successes and challenges with peers, exchanging informational support, such as mental health information and self-care strategies, and setting implementation intentions for the upcoming week. Of the 65 students that originally enrolled in the program, 57% attended at least two support group sessions and 34% attended all six support group sessions. Students who completed the entire program demonstrated significant improvements in well-being, although specific psychiatric symptoms were not evaluated over time. The low retention rate may be related to the recruitment method for the groups. Participants did not complete pre-screening assessments and were recruited based on whether they self-identified as experiencing anxiety or depression. Given that students with more severe mental

health symptoms were more likely to return and complete the program, it may be that students with fewer mental health concerns only needed a few sessions or realized that they were not currently in need of additional services. Thus, college students with elevated psychological symptoms may be a more appropriate fit for peer interventions.

Fontana et al. (1999) conducted a randomized controlled study design to evaluate the effectiveness of a skill-based peer intervention in decreasing anxiety symptoms among a college sample. They used a peer-led stress management intervention and measured state-anxiety levels and physiological outcomes among a non-clinical sample of college students (n = 18 in treatment group; n = 18 in waitlist control group). The intervention included six 45-minute sessions led by two student leaders with prior experience in leading peer group discussions. The leaders received training and weekly supervision from clinical psychologists and followed a written treatment manual for the peer intervention. In each session, student leaders presented psychoeducational material, encouraged participants to share current stressors and coping strategies, led skills training of stress-reduction techniques (e.g., deep breathing exercises, cognitive restructuring, problem-focused coping), and encouraged participants to practice techniques and monitor their effectiveness. Participants were assigned between-session homework and were prompted to share whether they had practiced the homework at the beginning of each session. All 36 participants attended the six treatment sessions and remained in the study from pre- to post-treatment. Despite the use of a non-clinical sample in Fontana et al. (1999), they appeared to demonstrate greater engagement and retention compared to the sample in Byrom (2018). High compliance with between-session homework was observed (95%), and the treatment group was found to have decreased stress-related physical symptoms and anxiety levels at posttreatment compared to a waitlist control group. Students rated peer leaders as very effective, suggesting

that college student peers are viewed as credible communicators of health information. Thus, Fontana et al. (1999) demonstrate that peer-led interventions can be effective in engaging college students in treatment as well as in reducing anxiety and stress symptoms.

As compared to the studies included in the meta-analysis by Pfeiffer et al. (2011), Fontana et al. (1999) was a skill-based peer intervention, which involved peers teaching and supporting other students in learning skills. Studies such as Byrom (2018) and Fontana et al. (1999) extend beyond the unstructured peer support groups found in prior research by focusing on skill-building and exchanging feedback between peer leaders and others in the group. In fact, skill-based peer interventions often produce better outcomes than peer interventions that are primarily supportive (Bryan & Arkowitz, 2015). While Sigurðardóttir et al. (2022) included a group component as an engagement strategy for a DMHI, the group was structured to review participants' understanding of the skills in a slideshow format, rather than fostering mutual support in completing the DMHI and applying the skills. Thus, research to date has primarily focused on standalone peer interventions and has not integrated DMHIs with formal peer-led groups. Consistent with dynamic social impact theory and social learning theory, college students may be more likely to apply behavior change techniques learned from a DMHI when they are reinforced by a credible peer. The inclusion of psychoeducational material from a DMHI may be especially beneficial when combined with the emotional, instructional, and appraisal support of peers. Given that students can learn the skills through the DMHI modules, peer leaders only need to assist with encouraging DMHI use and applying skills. This can also reduce the burden on mental health professionals to train the student leaders and lessen the amount of time required for each peer support meeting. Lastly, students may benefit from being

able to access the DMHI modules after completion of the program for a refresher on the psychoeducation material at a later date.

Peer Interventions as an Engagement Strategy

Available evidence suggests that peer interventions, particularly those focused on skills training and education, can potentially reduce depression and anxiety symptoms among college student populations. In standalone peer interventions, peers provide emotional and informational support to other students, resulting in improved mental health outcomes (Byrom, 2018; Fontana et al., 1999). Peers may be particularly influential in their ability to impact attitudes and behaviors of others given similar characteristics and physical proximity to other students, as well as when there are multiple sources communicating these attitudes and behaviors (Nowak et al., 1990). While these previous studies have been standalone peer interventions, a peer-led support group can potentially combat the engagement issues associated with DMHIs. College students may benefit from connecting with peers who are also enrolled in a DMHI. Difficulties related to motivation and self-discipline pose potential barriers to engagement with DMHIs, as reported by college students. Awareness that their peers are utilizing and benefiting from DMHIs could enhance their own engagement with these interventions (Reyes-Portillo et al., in press). Peer interventions can accomplish this through reviewing the information from the DMHI, helping students identify challenges and successes in completing the DMHI and using skills, crowdsourcing solutions from group members, and providing encouragement to persist in the treatment program.

Limitations of Existing Research

Previous literature has primarily focused on the effect of stand-alone peer interventions with psychological symptoms as the primary outcome measure. There is also a scarcity of

research examining whether peers are an acceptable alternative to mental health professionals for human support in DMHIs. No study to our knowledge has utilized a peer support group as an engagement strategy among DMHI users. Currently, research on skill-based peer interventions has examined the effectiveness of student peers in teaching and reinforcing psychoeducational material. Given the significance of peers in the college setting, peer support groups can potentially improve the engagement of students enrolled in DMHI programs for anxiety and depression.

The Present Study

Prior research reveals that DMHIs may serve to narrow the pervasive treatment gap that exists among college students in the United States. While DMHIs can be as efficacious as traditional mental health services in treating anxiety and depression, low engagement is a persistent issue. Research on DMHIs has primarily focused on other engagement techniques, such as therapist-guided support and automated reminders. Whereas human support from mental health professionals can effectively engage users, support from peers may be a more cost-effective and scalable engagement strategy.

To this author's knowledge, no study to date has empirically examined skill-based peer support groups as an engagement strategy for DMHIs, nor have any studies examined this effect among college students. The present study expanded upon the peer networking features of Ho et al. (2016) and Tomasino et al. (2017) by offering weekly peer support groups. These groups, conducted either in person or via teleconferencing, connect students experiencing anxiety and/or depression symptoms. By fostering connections among these students and reinforcing the skills from the DMHI, the likelihood of college students persisting in the treatment program may increase. Thus, this study evaluated the feasibility, acceptability, and initial efficacy of a peer

support group in enhancing user engagement in a DMHI (TAO) for college students with depression and anxiety symptoms. We used an open trial to measure enrollment, adherence, and retention rates, treatment fidelity, acceptability of TAO with peer support, as well as changes in depression and anxiety symptoms following a seven-week intervention period. Based on previous findings, we predicted that peer support groups would be a feasible and acceptable engagement strategy for anxious and depressed college students. Specifically, we hypothesized that:

H1: TAO with peer support will be a feasible intervention for college students with anxiety and/or depression, such that the peer support groups are implemented as intended (i.e., overall implementation adherence score of at least 80%).

H2: TAO with peer support will be acceptable to college students, as evidenced by: a) a high proportion of eligible students will enroll in the study (at least 60%), b) a low proportion of participants will drop out (less than 20%), c) a high proportion of students (at least 60%) will complete at least 50% of TAO modules, d) peer support group attendance will be high (at least 80%), and e) participants will report high levels of treatment satisfaction at post-treatment.

H3: TAO with peer support will demonstrate preliminary efficacy, such that participants will report a reduction in depression and anxiety symptoms from baseline to post-treatment.

Method

Recruitment

The Montclair State University Institutional Review Board (IRB) approved study procedures (IRB-FY22-23-2662). Recruitment was conducted in the Spring 2023 semester at a large public university in New Jersey. Undergraduate students ages 18–29 with elevated depression (PHQ-8 score between 10–17) and/or anxiety symptoms (SCAARED score $\geq$ 23)

were eligible to participate. Exclusionary criteria included current participation in psychotherapy or initiation of psychotropic medication within the previous eight weeks. Participants with a PHQ-8 score of 18 or higher, signifying moderately severe to severe depression, were advised to seek in-person therapy and provided with a referral to university counseling and psychological services, rendering them ineligible for the study. Students screened as part of a related study (MSU IRB-FY20-21-2077) were excluded if they reported any of the following: a) suicidal ideation in the past 2 weeks (C-SSRS = 2 or 3); b) suicidal intent or plan (C-SSRS = 4 or 5); c) a lifetime history of suicide attempts.

Students were informed about the opportunity to participate in the study through the following methods: 1) Those previously screened for elevated anxiety and depression in a related study (MSU IRB-FY20-21-2077), not meeting criteria for active suicidal ideation for that study, received notification of the present study via email; 2) An eligibility screening survey was made available on the university's online participant pool (SONA); 3) The study description and a link to the eligibility screening survey were disseminated through campus-wide e-mail newsletters to all students; 4) E-mails including the study description and a link to the screening survey were distributed to a listserv of all undergraduate psychology majors and minors at the university; 5) Psychology professors shared the study information and eligibility screening survey with their students; and 6) Flyers, including a description of the study and a QR code to the screening survey, were displayed in academic buildings on campus. Participants that accessed and completed the screening survey through the SONA participant pool received one SONA credit. Undergraduate students taking an introductory psychology course are required to complete a total of six SONA credits as part of their course requirements. Students who completed the

screening survey electronically provided informed consent, thereby granting permission for the study team to contact them if they were found eligible.

A total of 661 students completed the screening survey, with 461 completing the survey through the SONA participant pool, 57 through the related study (MSU IRB-FY20-21-2077), and 143 through other recruitment methods, including the e-mail newsletters. A total of 233 students were eligible based on the inclusion and exclusion criteria listed above. Of the 233 eligible students, 192 had accessed the survey through SONA, 11 through the related study, and 30 through other methods. From January to April 2023, all 233 were e-mailed with additional information about the study and an invitation to attend an orientation meeting with a member of the research team. Of the 233 students that were e-mailed with an invitation to participate in the study, 62 responded. Among the responders, 20 stated that they were unable to participate due to scheduling and time restraints, and 19 replied that they were not interested in participating. Two participants indicated interest in the study but did not respond to follow-up e-mails. One participant replied that they were interested in participating in the study, but they were enrolled in a related study conducted by the research team involving the same TAO modules and did not move forward with enrollment in the current study. The remaining 20 participants responded to the e-mail indicating their interest and were onboarded in the study. Of the final sample of participants (N = 20), 6 were recruited from the SONA participant pool, 5 from the related study (MSU IRB-FY20-21-2077), and 9 from various other sources such as campus-wide email newsletters and the psychology majors/minors listserv. See Figure 1 for a flowchart illustrating the recruitment process. Table 2 provides an overview of the recruitment and enrollment process for study participants. Participants who agreed to enroll in the study underwent an initial orientation session with a study team member. This orientation provided them with additional

information about the study and TAO, as well as the opportunity to review the consent form and ask any clarifying questions.

Participants

Demographics

The final sample of participants included 20 undergraduate college students from a public university in New Jersey aged 18–22 years old (M = 19.6, SD = 1.2) who reported elevated depression and/or anxiety symptoms. The demographic characteristics of the sample are presented in Table 1. Ninety percent (n = 18) of participants reported their sex assigned at birth as female. Fourteen participants identified as women (70%), two identified as men (10%), and four identified as genderqueer, gender fluid, or non-binary (20%). Regarding racial identity, participants could choose multiple races, with the majority of participants selecting White as one of their racial identities (n = 12, 60%). A comprehensive breakdown of participants' racial identification is presented in Table 1. Additionally, 50% of enrolled participants identified as Hispanic or Latinx. In terms of student year, the distribution was as follows: 45% freshmen, 10% sophomore, 35% juniors, and 10% seniors. All participants endorsed smartphone ownership. For a detailed breakdown of technology usage reported by participants at the baseline, see Table 3. Of the twenty participants enrolled in the study, eight had received counseling or therapy for mental health concerns prior to study enrollment.

Assessments

Participants were evaluated at baseline, three weeks, and seven weeks. All assessments were conducted digitally through Qualtrics. During the first peer support group session, participants were allocated time to complete the baseline assessment. The three-week and seven-week assessments were distributed to participants via e-mail. Participants could receive up to a

total of $60 in Amazon gift cards for completion of the online surveys. They received $15 for completing the baseline survey, $20 for completing the three-week survey, and $25 for completing the seven-week survey.

Measures

Depression and Anxiety Symptoms

The Patient Health Questionnaire (PHQ-9; Spitzer et al., 1999) consists of nine items that assess the frequency of depressive symptoms in the previous two weeks on a four-point scale, ranging from zero (*Not at all*) to three (*Nearly every day*). The items inquire about symptoms such as loss of interest, depressed mood, changes in sleep and appetite, and difficulty concentrating. Scores for the PHQ-9 range from 0 to 27, and the clinical cutoff for moderate depressive severity is 10. For the study assessments, the PHQ-8 was administered. The PHQ-8 excludes item nine of the PHQ-9, which assesses thoughts of death and self-harm. Previous studies have found the removal of this item to minimally affect overall scores, demonstrating correlations of above .90 between the PHQ-9 and PHQ-8 (Kroenke et al., 2010). Given that the current study is focused on students who are not at risk of suicidal thoughts or behaviors, the use of the PHQ-8 is appropriate for determining depression severity in this sample. The PHQ-8 scores range from 0 to 24, and the clinical cutoff for moderate depressive severity is 10. The present study used a score of 10 as a positive screen for depression. Individuals whose PHQ-8 score on the screening survey was 18 or higher, indicating moderately severe to severe depression, received a recommendation to pursue in-person therapy with a referral to university counseling and psychological services. The PHQ has high test-retest reliability over a period of 14 days ($r = .94$; Zuithoff et al., 2010) and is a valid measure of depressive severity (Löwe et al., 2004). Participants completed the PHQ-8 at baseline, three weeks, and seven weeks.

The Screen for Adult Anxiety Related Disorders (SCAARED; Angulo et al., 2017) includes 44 items evaluating anxiety symptom severity on a three-point scale, ranging from zero (*Not at all*) to three (*Nearly every day*). An overall score of at least 23 is a commonly used cutoff indicating clinically significant anxiety and a high likelihood of meeting criteria for an anxiety disorder. The SCAARED also includes four subscales for the assessment of more specific anxiety disorders: Generalized Anxiety, Social Anxiety, Panic Disorder/Significant Somatic Symptoms, and Separation Anxiety Disorder. Angulo et al. (2017) found good discriminant validity between the Generalized Anxiety and Social Anxiety SCAARED subscales as well as between anxious and depressed participants using the SCAARED as an assessment tool. Participants completed the SCAARED at baseline, three weeks, and seven weeks.

Perceived Social Support

The Social Provisions Scale (SPS; Cutrona & Russell, 1987) is a 24-item self-report instrument that measures perceived social support on a four-point scale, ranging from one (*Strongly disagree*) to four (*Strongly agree*). The measure captures the six dimensions of social support proposed by Weiss (1974): attachment, social integration, reassurance of worth, reliable alliance, guidance, and opportunity for nurturance. Four items, two positively worded and two negatively worded, correspond to each dimension, and negatively worded items were reverse-coded. Sum scores for the scale can range from 24 to 96 with higher scores indicating greater levels of perceived social support. Previous studies have linked higher PSS scores with reduced loneliness among college students (Friedlander et al., 2007). Participants completed the SPS at baseline, three weeks, and seven weeks.

Technology Use

Students reported their technology use, such as whether they own a smartphone, which smartphone apps they use the most frequently, and how many hours per day they spent using social media sites, apps, services, and/or games. Participants shared details of their technology use at baseline.

Mental Health Service Use

The utilization of mental health services and mental health attitudes was assessed during the baseline assessment using eight items from the Healthy Minds Survey (Eisenberg & Lipson, 2020). The questions assessed prior mental health treatment, attitudes towards mental health, and barriers to help-seeking. Students reported whether they had ever received counseling or therapy for mental health concerns, if they had needed help for emotional or mental health problems in the previous 12 months, if they needed help in addressing current mental health issues, and the total number of counseling or therapy sessions they attended in the past 12 months. Students also shared perceived barriers that may have interfered with their ability to receive sufficient mental health treatment in the past 12 months (e.g., financial reasons, not enough time).

Treatment Engagement and Acceptability

Engagement was also measured by items of the Digital Behavior Change Interventions (DBCI) Engagement Scale (Perski et al., 2020) that were adapted for the present study. “Please answer the following questions with regards to your most recent use of the Therapy Assistance Online (TAO) modules. How strongly did you experience the following?” was presented with the following words: interest, intrigue, focus, inattention, distraction, enjoyment, pleasure, and annoyance. Response options were shown on a Likert scale from one (*Not at all*) to seven

(*Extremely*). Participants also reported the average amount of time that they spent on TAO each week. Participants completed the DBCI Engagement Scale at three weeks and seven weeks.

Acceptability was measured by the number of students that agreed to enroll in the study, the proportion that dropped out of the study after enrolling, the average number of completed TAO modules, the group session attendance rates, and post-treatment satisfaction ratings. As part of the seven-week assessment, participants answered a series of questions developed for the present study to evaluate their satisfaction with the overall program, TAO, and the peer support groups. They responded to Likert scale questions assessing the extent to which the treatment program helped improve their depression and anxiety symptoms and their overall situation, the ease of use and navigation of TAO, the effectiveness of the peer support group in enhancing their engagement with TAO, and whether they would recommend the treatment program to a friend. These items were rated on a five-point response scale, ranging from one (*Not at all*) to five (*Extremely*). Additionally, participants were asked whether technical support was available for TAO and what barriers may have interfered with their completion of TAO. Participants also answered four open-ended questions regarding what they liked about the treatment program, to what extent the peer support groups helped them engage in TAO and to apply the skills, and suggestions for changes to the program.

Treatment

Therapy Assistance Online (TAO)

TAO is an online program that provides interactive, self-paced modules containing evidence-based strategies for stress, anxiety, depression, relationship issues, and other mental health concerns. It is provided free of charge to students, faculty, and staff at the university. TAO is private, encrypted from end-to-end, and HIPAA compliant. Participants were asked to

complete a transdiagnostic course of modules targeting anxiety and depression symptoms. Specifically, the modules included psychoeducational videos and interactive activities on sources of well-being, anxiety, depression traps, values identification, facing fears, etc. The TAO treatment plan included a total of 16 modules. Throughout the seven-week intervention period, students were assigned one to three modules weekly, with each module requiring approximately 10 to 30 minutes to complete. The modules addressing depression symptoms draw upon behavioral activation, an evidence-based therapeutic approach centered around engaging in activities that enhance contact with positive reinforcements and reduce avoidance behaviors. Behavioral activation has been shown to be effective in lowering depression severity (Cuijpers et al., 2007; Gawrysiak et al., 2009) and anxiety symptoms (Chu et al., 2016; Lee et al., 2022), and has previously been implemented in skill-based peer interventions (Byrom, 2018) and self-guided DMHIs (Weitzel et al., 2022), demonstrating increases in engagement of pleasant activities and greater psychological well-being. Specifically, the TAO behavioral activation course includes skills such as recognizing triggers for depression, creating an activation plan, problem-solving, and improving thinking habits. The TAO treatment plan incorporated additional modules rooted in evidence-based treatments for depression and anxiety, including exposure therapy, cognitive restructuring, and mindfulness. The psychoeducational videos and activities in these modules focus on identifying and reframing anxious thought patterns, facing fears, and practicing mindfulness and relaxation techniques. See Appendix 1 for an example of the program's schedule, listing the TAO modules assigned for each week.

Peer Support Group Engagement Intervention

At the first peer support group meeting, participants received instructions on which TAO modules to complete, along with additional details about the peer support group meetings.

Students were asked to complete one to three modules per week for seven weeks. Each week, they received an email with reminders to complete modules and to attend the peer support group. Participants either attended peer support groups in a conference room at the college campus or in a virtual meeting room using Zoom teleconferencing software. There was a total of five peer support groups with three to five participants in each group. Peer support groups were 30 to 60 minutes on a weekly basis for six weeks and were audio recorded with a digital recorder. Participants were asked to attend a peer support group on a weekly basis for six weeks as they completed the TAO treatment plan.

From February to June 2023, participants were placed into one of five groups, and each group included between three to five participants. The meetings for groups 1, 2, and 3 were held in person in classrooms on the university campus, and the meetings for groups 5 and 6 were held virtually using Zoom video/audio teleconferencing software. Each group met weekly for six meetings. Refer to Table 5 for additional information regarding the peer support groups.

Each peer support meeting was between 30 to 60 minutes long, with most meetings averaging 45 minutes. Each group meeting focused on reviewing and checking in on completion of the assigned TAO modules. The objective of the peer support group was to provide group members with information, feedback, and emotional support to facilitate their engagement with TAO and skills implementation. While previous studies on peer interventions included skills training during the sessions (Byrom, 2018; Fontana et al., 1999), the teaching of skills in the present study occurred through completion of the TAO modules.

Given that the current study was a pilot aimed at testing the feasibility of the peer support model before introducing undergraduate students as peer leaders, the principal investigator acted as the group facilitator for all meetings. The group facilitator in the present study had the

following responsibilities: 1) Help participants identify their wellness goals, 2) Facilitate discussion of successes and challenges in completing TAO, 3) Briefly review TAO skills, 4) Encourage participants to validate each other's challenges and praise each other's successes, 5) Encourage participants to provide advice and feedback to each other on completing TAO modules and applying TAO skills, 6) Encourage participants to share goals for completing TAO and using TAO skills in upcoming week, and 7) Remind group members of assigned TAO modules for upcoming week. Similar to Byrom's (2018) study, the group facilitator encouraged participants to reflect on their recent successes and challenges, work together to identify how to apply skills when faced with challenges, and share their implementation intentions for the upcoming week. Each meeting ended with setting goals for completing TAO and applying the TAO skills in the upcoming week.

Group meetings were audio-recorded to monitor implementation fidelity. During the first peer support group meeting, participants provided consent to be audio-recorded through a Qualtrics form. Participants also signed a group confidentiality form, in which they agreed to keep the identities of others in the group private. After completing the forms, participants completed the baseline survey, which asked additional questions about participants' social relationships, technology use, attitudes towards mental health, and whether they previously received mental health treatment. Next, participants were guided through the process of signing up for TAO and enrolling in the TAO treatment course. This enrollment allowed participants to easily access the assigned modules as part of the treatment plan. In addition, participants received instructions on downloading the mobile app for their smartphones. The group facilitator then prompted participants to share their wellness for the study. Participants also discussed potential barriers they anticipated might interfere with the completion of TAO modules. The

group facilitator encouraged participants to identify and share solutions for potential barriers. Lastly, participants were reminded of the TAO modules assigned for the upcoming week. Group meetings 2 through 6 started with an icebreaker discussion question to help group members get acquainted. During in-person group meetings, attendees were offered light snacks and beverages to enhance comfort within the group environment. Facilitators briefly reviewed the skills from the previously assigned TAO modules and invited participants to reflect on successes and challenges on completing TAO modules and practicing the skills. At each meeting, participants were reminded of TAO modules assigned for the following week. See Appendix 2 for a detailed description outlining the format of each peer group meeting.

Group Leaders

Each group meeting was facilitated by the principal investigator of the study, a female doctoral student in clinical psychology. Based on availability of undergraduate research assistants, two groups also included an undergraduate peer co-leader (see Table 5). The undergraduate peer co-leaders (both female) had previous experience with using TAO and received three hours of training from the principal investigator on reviewing skills, validation, goal setting, and providing feedback. The peer co-leaders assisted with facilitating the group sessions using a manual guide outlining the leader's responsibility for peer group support, detailed above. Peer co-leaders attended 10-minute weekly check-ins with the principal investigator.

Peer Group Implementation Fidelity

Implementation fidelity refers to the degree to which an intervention is carried out according to its intended design (Carroll et al., 2007). The success of an intervention in improving symptoms is associated with the fidelity with which it is implemented. Thus, to

accurately interpret treatment effects, there must be a level of confidence in the execution of the treatment as intended. Perepletchikova and Kazdin (2005) put forth guidelines reflecting the current state of literature on implementation fidelity in treatment outcome studies. They proposed that an administered intervention of high integrity falls within the range of 80–100% adherence. Moreover, Perepletchikova and Kazdin (2005) recommended that implementation studies incorporate a treatment manual outlining the treatment rationale and procedures. The peer support groups were structured by a manual guide created for the present study and focused on facilitating completion of the TAO modules and implementation of the skills in daily life. Each peer support group meeting was audio recorded and transcribed. Implementation fidelity to treatment-specific content in each peer support session was measured using a fidelity checklist (see Appendix 3). The principal investigator reviewed the transcriptions and completed the fidelity checklist for each session. Each component of the group session received a rating of 0 (*non-adherent*) or 1 (*adherent*) to assess the inclusion of program manual-specified components during a specific group meeting. A session was considered adherent if at least 80% of the session-specific content was rated as adherent (Perepletchikova & Kazdin, 2005).

Data Analytic Plan

Preliminary Analyses

All study analyses were conducted using SPSS 29.0 (IBM Corp, 2022). Preliminary analyses included descriptive statistics of study variables at baseline, three weeks, and seven weeks. Means and standard deviations were calculated for continuous variables, and frequencies were calculated for categorical variables.

Primary Data Analyses

Hypothesis 1

To determine whether TAO with peer support would be a feasible intervention for college students with anxiety and/or depression, we evaluated the extent to which the peer support groups were implemented as intended. We expected that at least 80% of the peer group content would be rated as adherent to the program manual in each session (Perepletchikova & Kazdin, 2005). The principal investigator reviewed transcriptions of each peer support group meeting and calculated the implementation fidelity according to the fidelity checklist in Appendix 3. Each component of the group session received a rating of 0 (*non-adherent*) or 1 (*adherent*) to assess the inclusion of program manual-specified components during that specific group meeting, and the percentage of adherent components was calculated for each peer support meeting. Implementation fidelity scores were derived by calculating means for each group across the six sessions, as well as an overall mean for the entire program, encompassing all sessions across the five groups.

Hypothesis 2

Several aspects of this study were used to evaluate the acceptability of TAO with peer support. We measured the enrollment rates by calculating the percentage of eligible students that ultimately agreed to enroll in the study and attended at least one peer support group meeting. Dropout rates were also calculated by measuring the number of participants that discontinued participation after enrolling. A participant was considered to have dropped out if they had notified the study team that they no longer wished to participate after the first peer group meeting, or if they had stopped participating in all activities of the research study (i.e., peer support group meetings, TAO modules, assessments) and were unresponsive to communications

from the study team. Treatment adherence was measured by the number of enrolled participants who completed at least 50% of the 16 assigned modules. The overall percentage of completed TAO modules and the average number of TAO modules completed per participant was computed. Peer support group attendance was evaluated by calculating the number of peer support groups attended by participants out of the six possible meetings. The overall percentage of group meetings attended by participants and average number of group meetings attended per participant was calculated.

Engagement was also measured by the mean item scores calculated for each item on the DBCI Engagement Scale. Participants were considered to be responding positively to the intervention if their responses were above the midpoint (4) for interest, intrigue, focus, enjoyment, and pleasure, and below the midpoint (4) for inattention, distraction, and annoyance. In addition, 12 treatment satisfaction questionnaires were administered to participants at the seven-week assessment. Descriptive statistics were calculated for these items, including mean and standard deviation scores, as listed in Table 6. The open-ended response questions were reviewed and sorted by the principal investigator.

Hypothesis 3

We hypothesized that TAO with peer support would result in significant reductions in depression and anxiety symptoms over the seven-week intervention period. We examined changes in symptoms from pre- to post-treatment using paired *t*-tests. For participants with partial missing data, cases were excluded listwise per analysis. Consequently, the one participant that was considered a dropout was removed from these analyses. Two paired *t*-tests compared anxiety (SCAARED scores) and depression (PHQ-8) scores at baseline and seven weeks. Additionally, a paired *t*-test compared perceived social support (SPS) at baseline and seven

weeks. Effect sizes using Cohen's *d* and their 95% confidence intervals were computed. Cohen's *d* values of ±0.20 are considered small effects, values ±0.50 are considered medium effects, values ±0.80 or greater are considered large effects.

Results

Baseline Service Use

Service Use

Of the twenty participants enrolled in the study, eight had received counseling or therapy for mental health concerns prior to study enrollment. Most participants reported no visits for counseling or therapy in the past twelve months (70%). Of the six participants that received therapy in the past year, half received one to three sessions, while the other three participants received four or more sessions. The most common reasons cited by the total sample (N = 20) for receiving fewer mental health services in the past year were lack of time (45%), financial constraints (45%), preferring to deal with issues on their own or with support from family/friends (45%), and being unsure where to go for services (40%).

On the seven-week survey, seven participants answered a question assessing how effective previous counseling or therapy was in addressing their mental health concerns. In the baseline survey, eight participants indicated that they had previously received therapy prior to enrolling in the study; one of these participants dropped out of the study and did not complete the seven-week survey. From 1 = *Not at all effective* to 4 = *Extremely effective*, the average score was between *slightly* to *moderately* effective (M = 2.14, SD = 0.90). With regard to the effectiveness of prior therapy, two participants responded with *Not at all effective* (28.6%), two participants indicated *slightly effective* (28.6%), and three participants indicated *moderately effective* (42.9%).

Attitudes

At baseline, participants were asked a series of questions inquiring about their attitudes towards mental health. All participants endorsed a minimum of "*somewhat agree*" when asked whether they needed help for emotional or mental health problems such as feeling sad, blue, anxious, or nervous in the past 12 months. The breakdown of responses reveals that six participants expressed "s*omewhat agree*," six participants endorsed "*agree*," and eight participants affirmed "*strongly agree*." When asked about their current need for help in addressing emotional or mental health issues, one participant endorsed "*disagree*," and the remaining nineteen participants expressed a continuing need for assistance, with eleven endorsing "*somewhat agree*," four endorsing "*agree*," and three endorsing "*strongly agree*." Table 4 presents a full overview of mental health attitudes and service utilization at baseline.

Implementation Fidelity

We hypothesized that TAO with peer support would be a feasible intervention for college students with elevated anxiety and/or depression symptoms. We predicted that the group leader(s) would implement the peer support groups as intended by the program manual, with average implementation fidelity scores of at least 80% for each group and for the overall program. The Peer Support Group Fidelity Checklist, as shown in Appendix 3, outlines the content of the program manual developed by the principal investigator. Our hypothesis was supported, with an overall fidelity score of 97.8% across all groups. Groups 4 and 5 were fully adherent to the manual, with average scores of 100% across all meetings. Groups 1 and 2 were 97.2% adherent, and Group 3 was 94.4% adherent. Further details are provided in Table 5.

Acceptability

Enrollment and Retention

We hypothesized that TAO with peer support would be acceptable to college students as evidenced by a high proportion of eligible students enrolling in the study (at least 60%). This hypothesis was not supported, such that of the 233 students that were deemed eligible by the screening surveys, only 20 students agreed to participate (8.6%). However, the enrollment rates widely differed by recruitment source. Of the 192 eligible students from the SONA participant pool, 6 enrolled (3.1%). Of the 11 eligible from the related study, 5 enrolled (45.5%), and of the 30 students eligible from other sources including the campus-wide e-mail newsletters, 9 enrolled (30%).

We also hypothesized that a low proportion of participants would drop out (less than 20%). This hypothesis was supported. One participant dropped out of the study, resulting in a 5% drop-out rate. This participant only attended the first peer support group and completed the baseline assessment. They were considered a drop-out given that they did not attend future peer support groups, did not complete any TAO modules, and did not complete the three-week or the seven-week assessments. This participant did not respond to messages from the research team. Therefore, it is unclear what prompted the participant to drop out from the study.

TAO Module Completion

Our prediction that a high proportion (at least 60%) of participants would complete at least 50% of the 16 assigned TAO modules was supported. Of the participants who initially enrolled (N = 20), only one participant did not complete at least 50% of the TAO modules, which was the participant who dropped out of the study. This resulted in an overall module adherence rate of 86.56% for the N = 20 sample. Of the remaining 19 participants, the overall TAO module

adherence rate for the 16 assigned modules was 91.12%. The mean number of modules completed was 13.85 for the entire sample (*SD* = 3.65), and 14.58 (*SD* = 1.68) for those who remained enrolled (*n* = 19). The final assigned module was a review module that participants were encouraged to complete after the final peer support meeting, and only six participants completed the review module. Participants also shared information about the devices they used to access TAO throughout the study. Nearly three-fourths of participants (74%) completed TAO modules on their computer. Additionally, 63% reported accessing TAO via smartphone, while 11% reported using a tablet. Refer to Table 2 for details regarding TAO module adherence.

Peer Support Group Attendance

Participants were asked to attend six peer support group meetings over the course of the seven-week study. Our hypothesis that peer support group attendance will be high (at least 80%) was supported by the current study. Of the 20 participants initially enrolled, the overall attendance rate was 83.33%, and of the 19 participants remaining, the overall attendance rate was 86.84%. Of all participants, the mean number of peer support groups attended was 4.95 (*SD* = 1.15) and of the final sample (*N* = 19), the mean number of peer support groups attended was 5.16 (*SD* = 0.69). Most participants attended 5 out of 6 peer support group meetings. The least number of peer support group meetings was attended by the one participant that dropped out after the first meeting. All other participants attended between four to six meetings. The mean number of meetings attended per participant in each group were as follows: Group 1 averaged 4.8 meetings, Group 2 averaged 5.0 meetings, Group 3 averaged 4.7 meetings, Group 4 averaged 5.3 meetings, and Group 5 averaged 5.0 meetings (or 6.0 when excluding dropouts). See Tables 2 and 5 for information on peer support group attendance.

DBCI Engagement Scale

At three and seven weeks, engagement in TAO modules was also measured by items of the Digital Behavior Changes Interventions (DBCI) Engagement Scale (Perski et al., 2020) that were adapted for the present study. Participants reported how strongly they experienced each of the following emotions with regard to their most recent use of TAO: interest, intrigue, focus, inattention, distraction, enjoyment, pleasure, and annoyance. Participants responded to each item on a Likert scale from one (*Not at all*) to seven (*Extremely*). Table 6 presents the average ratings and the ranges of the DBCI Engagement Scale items at three and seven weeks. At both timepoints, participants reported mean levels of interest (5.16, 5.32), intrigue (5.00, 5.32), focus (4.53, 4.84), enjoyment (5.05, 5.37), and pleasure (5.00, 5.47) that were higher than the midpoint. On average, participants reported levels of inattention (3.11, 3.33), distraction (3.32, 3.32), and annoyance (2.53, 2.16) that were below the midpoint of 4 at both timepoints. While this is a newer measure with limited information on its psychometric properties, it appears that participants experienced somewhat higher levels of positive emotions and lower levels of negative emotions while completing TAO.

Participants were asked to provide an open-ended response detailing the approximate time they spent on TAO each week. At three weeks, all nineteen participants reported spending between 15 to 60 minutes on average to complete the TAO modules weekly. By the seventh week, eighteen participants maintained an average time commitment between 30 minutes to an hour, and one participant reported spending one to two hours per week on TAO.

Intervention Satisfaction

Satisfaction with Overall Program

We also predicted that participants would report high levels of treatment satisfaction at post-treatment. At seven weeks, nineteen participants completed a series of questions relating to satisfaction with the overall treatment program, TAO, and the peer support groups (see Table 7). On a scale from one (*Not at all*) to five (*Extremely*), participants on average reported that the treatment program (i.e., TAO with peer support) has *moderately* to *very much* helped improve their depression/anxiety symptoms (M = 3.21, SD = 0.79) and their overall situation (M = 3.32, SD = 0.95). Participants were, on average, *moderately* to *very much* satisfied with the overall treatment program (M = 3.84, SD = 0.69). On average, participants reported that they were between *very much* to *extremely* satisfied with participating in the study (M = 4.26, SD = 0.73) and that it is *very much* likely that they would recommend TAO with peer support to a friend (M = 4.05, SD = 0.91).

Satisfaction with TAO

On a scale from one (*Not at all*) to five (*Extremely*), participants generally found the TAO website and application to be between *very much* to *extremely* easy to use (M = 4.58, SD = 0.84) and navigate (M = 4.58, SD = 0.77). Nearly all (95%) participants reported that they did not need technical support while using TAO. On average, participants were between *moderately* to *very much* willing to complete the TAO modules (M = 3.89, SD = 0.81). Participants found the e-mail reminders to be *very much* to *extremely* helpful in completing the TAO modules (M = 4.47, SD = 0.91) and reported that the peer support group *very much* helped them to complete TAO modules (M = 4.00, SD = 1.11).

Satisfaction with Peer Support Groups

Items assessing satisfaction with the peer support groups were also recorded on a Likert-type with response options ranging from one (*Not at all*) to five (*Extremely*). Regarding the peer support group, participants reported that it was, on average, *very much* helpful in coping with their depression or anxiety (M = 4.00, SD = 0.94). They reported that they were between *very much* to *extremely* willing to attend the peer support group (M = 4.47, SD = 0.51). Participants also disclosed factors that interfered with their engagement with the TAO modules. The most frequently endorsed factors were having a busy schedule (89%), lacking motivation (53%), and forgetting to work on the modules (58%). One participant endorsed technical issues, such as the app crashing or difficulty connecting to Wi-Fi.

Post-Study Enrollment in Psychotherapy

Of the nineteen participants who completed the seven-week survey, six participants (32%) reported that they had started receiving therapy for mental health concerns. These participants had either begun therapy in the final weeks of the study or had scheduled their initial appointments in the weeks following the study's completion.

Open-Ended Responses

Satisfaction with Overall Program

As part of the seven-week survey, four open-ended questions allowed participants to offer feedback regarding their satisfaction with the program. The first question prompted participants to share aspects that they liked most about the overall treatment program (i.e., TAO with peer support). Several participants reported that they appreciated completing the program at the same time as other students who share similar struggles with depression and anxiety. Some responses included: “I enjoyed knowing I was not going through the process alone,” and “I really

enjoyed engaging with others and providing advice based on my own experiences and accepting advice from others. It was great to feel listened to." Other participants liked that they had the opportunity to discuss the skills from TAO with other group members. One participant shared, "Talking about the strategies introduced in TAO with other people definitely helped me understand them better, especially how to introduce the strategies into my own life." Participants commended specific features of TAO, citing the organization of modules as a favorable aspect: "I liked that it was sectioned and organized in a way that allowed me to view which module I could do very easily." Additionally, participants lauded TAO's incorporation of real-life examples illustrating psychoeducational concepts. A participant said:

> I liked how the modules had examples for us to look through and see how depression and anxiety affected their lives, so it could help us see the affect [sic] it has on our lives. There were times where I did not quite understand the topic, but the examples helped me understand right away.

Peer Support Groups and TAO Module Completion

Participants were prompted to describe how much the peer support groups had facilitated their progress in completing the TAO modules. Notably, participants underscored the role of peer support groups in motivating them to complete TAO modules. Multiple respondents attested to the motivational impact of sharing common challenges with peers, finding collective motivation in navigating similar struggles. In particular, one participant noted:

> I loved getting to meet new people even for this short period of time. It was nice to come in a group where we didn't really know each other and we could share our worries freely without judgment. I loved being able to hear about other people's lives and being able to take some of their solutions for my own problems.

Another participant wrote, “I also enjoyed sitting with others that were also struggling with depression or anxiety just like me and learning about their thoughts and feelings.” Participants also expressed that the peer support group contributed to maintaining their accountability in completing the TAO modules. A participant reported, “They were really helpful, I felt like I needed to keep up in order to ensure I could participate in the meetings.” Another participant said, “[T]he two other individuals shared how it was slightly difficult to complete but still did. This helped motivate me to do the same regardless of my lack [of] motivation.” Furthermore, one response indicated that attending the meetings increased their interest in completing TAO. “[The group facilitator] went over the TAO modules thoroughly each week which helped me understand them better and gave me interest in completing them.” Still, other responses indicated that the e-mail reminders were equally or more helpful in reminding participants to complete the TAO modules. One participant stated, “I found that the email reminders were the best method in getting me to complete modules,” whereas another said, “Reminders from [group facilitator] via email and when meeting in person helped me to complete the TAO modules.”

Peer Support Groups and Skills Application

Participants also shared feedback on how helpful the peer support groups were in encouraging them to apply the skills learned from the TAO modules. Several participants reported that the groups allowed them to share feedback and ideas amongst themselves. One participant shared, “The personalized solutions provided by the group definitely helped me implement the strategies better into my own life, so I’d say they were very helpful.” Another wrote that the group helped them recall and apply the skills from TAO: “They reminded me about the SMART goals and through our discussions helped me to find new ways to avoid triggers.” Feedback from a participant indicated that the group setting allowed them to reflect on

their own skill usage: "[It helped] very much since we would always be asked to share our experience with the skill and if it helped you that week." Other participants found the peer support group slightly less helpful in this regard, such that one participant shared, "Sometimes I would just forget to apply what I was learning" and another participant expressed a preference for individual therapy.

Feedback for Improving the Treatment Program

Participants also provided suggestions for improving the TAO with peer support program. Four participants recommended extending the length of the group sessions. One participant shared the following:

> Maybe more structure, and if possible longer sessions than 45 min, though it may be difficult to get people to join. I've been to IOP and I liked that each person had a good amount of time to share and speak with the group, and that we were able to get deeper into different issues with more time.

Some participants proposed expanding the group size to accommodate more members, and one comment recommended extending the time allocated for completing the TAO modules between meetings. Moreover, several participants offered no suggestions, with one stating, "I feel like there is nothing to change. It was great on its own."

Initial Efficacy

Depression and Anxiety

At baseline, the total sample of 20 participants scored a mean of 12.25 (*SD* = 4.13) on the PHQ-8 depression measure and a mean of 51.45 (*SD* = 15.87) on the SCAARED anxiety measure. A score of 10 on the PHQ-8 is regarded as a threshold for moderate depression

(Kroenke et al., 2010). A score of 23 or higher on the SCAARED indicates a high likelihood of meeting criteria for an anxiety disorder (Angulo et al., 2017). The final sample (N=20) was moderately depressed on average and had a clinically significant level of anxiety far above the threshold indicative of meeting criteria for an anxiety disorder. At the baseline assessment, 13 participants (65%) had PHQ scores above the clinical cutoff for moderate depression. All 20 participants (100%) scored above the clinical cutoff for anxiety on the SCAARED. Excluding the participant who withdrew from the study (n = 19), 12 participants (63%) initially scored above the clinical cutoff for moderate depression on the PHQ, and all 19 participants (100%) scored above the clinical cutoff for anxiety on the SCAARED. By three weeks, 10 participants (53%) had moderate depression and 18 participants (95%) had clinically significant anxiety. At seven weeks, the numbers decreased to 8 participants (42%) with moderate depression and 16 participants (84%) with clinically significant anxiety.

See Table 8 for depression, anxiety, and perceived social support levels at baseline, three weeks, and seven weeks. We hypothesized that TAO with peer support would demonstrate initial efficacy, such that participants would report decreased depression and anxiety symptoms from baseline to post-treatment. Nineteen participants who completed assessments at baseline, three weeks, and seven weeks, were included in the analyses. Two paired t-tests compared anxiety (SCAARED) and depression (PHQ-8) scores from baseline to seven weeks. At an alpha cutoff level of p = .05, total SCAARED scores were found to significantly decrease from an average sum score of 50.53 (SD = 15.74) at baseline to 39.74 (SD = 14.81) at seven weeks, t = 2.53, df = 18, p = .021. Total PHQ-8 significantly decreased from an average sum score of 12.00 (SD = 4.08) at baseline to 8.79 (SD = 4.84) at seven weeks, t = 2.72. df = 18, p = .014.

Perceived Social Support

Participants achieved a mean score of 68.50 (*SD* = 10.28) on the Social Provisions Scale (SPS) at baseline. The SPS has a range of 24 to 96, such that higher scores signify greater levels of perceived social support. On average, participants reported levels of perceived social support that surpass the midpoint of 60.

It is also notable that levels of perceived social support, as measured by the Social Provisions Scale (SPS), changed over the course of the program. A paired *t*-test found that perceived social support significantly increased from an average sum score of 68.84 (*SD* = 10.45) at baseline to 74.68 (*SD* = 7.78) at seven weeks.

Discussion

The present study was an open pilot evaluating the feasibility, acceptability, and initial efficacy of a brief, skill-based peer support group as an engagement strategy for college students completing a DMHI targeting depression and anxiety symptoms. We hypothesized that the group leaders would implement the peer support groups as intended and specified by the program manual (i.e., overall adherence score of at least 80%). We also hypothesized that college students would find TAO with peer support to be an acceptable intervention, as evidenced by a) a high proportion of eligible students will enroll in the study (at least 60%), b) a low proportion of participants will drop out (less than 20%), c) a high proportion of students (at least 60%) will complete at least 50% of TAO modules, d) peer support group attendance will be high (at least 80%), and e) participants will report high levels of treatment satisfaction at post-treatment. Lastly, we predicted that TAO with peer support would exhibit initial efficacy, such that participants would report a decrease in depression and anxiety symptoms from baseline to seven weeks.

Implementation Fidelity

As hypothesized, the peer support groups were implemented as intended by the principal investigator using the program manual. The overall implementation fidelity to the manual was 97.8% across all group meetings. In this pilot study, the principal investigator (EK), a graduate student in clinical psychology, assumed the role of group leader for all five groups, and two groups had undergraduate co-leaders. Undergraduate co-leaders were selected to co-facilitate based on availability. Groups 1, 2, and 3 were held in person on campus, and groups 4 and 5 were held virtually on Zoom. Implementation fidelity was consistently high despite variations in delivery methods (i.e., in-person vs. Zoom) and the inclusion of undergraduate facilitators. Given that the principal investigator (EK) was the group leader and the treatment developer, the implementation fidelity could be lower when groups are led only by undergraduate students.

Attendance rates remained relatively consistent between in-person and Zoom groups. Offering support groups via Zoom provides a flexible option for participants who live off-campus or may find it inconvenient to commute for an in-person meeting. For some participants in the virtual group, challenges in securing reliable transportation were mitigated by the availability of Zoom sessions, therefore overcoming a potential barrier to participation. However, online groups also pose certain challenges. Ensuring privacy during online groups can be more difficult. While online therapy offers the convenience of joining from the comfort of one's home, it becomes problematic if participants do not have access to a private space. In such cases, participants were asked to relocate to a more secluded area. Occasionally, the online groups encountered issues such as unstable internet connections. Zoom meetings are also limited to allowing one person to speak at a time, deviating from the natural flow of in-person conversations. Furthermore, there is limited research available on group cohesion within the context of online therapy and support groups.

Acceptability

Enrollment and Retention

We hypothesized that TAO with peer support would be an acceptable intervention to college students with depression and anxiety symptoms. This hypothesis was mostly supported, as evidenced by high TAO module completion rates, high peer support group attendance rates, low dropout rates, and high satisfaction reported by participants. Overall enrollment in the program was low, with 8.6% of the 233 eligible students participating in the study. The lower-than-expected enrollment rates may be attributed to our recruitment strategies, particularly the use of the SONA participant pool for screening participants. Despite the ability to screen hundreds of undergraduate students through SONA, only six enrolled in the program, resulting in a recruitment rate of 3.1% among SONA users. This low uptake could be attributed to students fulfilling their obligation for six SONA credits as part of their introductory psychology course requirements, possibly leading to a lack of interest in further engagement after screening. The other recruitment approaches yielded more promising results. Students previously screened for a related research study on DMHIs for individuals with suicidal ideation (MSU IRB-FY20-21-2077), who were ineligible due to lack of recent suicidal thoughts, were invited to participate in our study. Given that 45.5% of the eligible students from the related study enrolled in the study, these individuals most likely possessed a heightened motivation for engaging in DMHI research and a greater awareness of their mental health needs. Additionally, we utilized other recruitment strategies for the current study, including campus-wide e-mail newsletters, e-mails to psychology majors and minors, e-mails distributed by psychology professors to their students, and flyers in academic buildings on campus. Thirty percent of the eligible students recruited through these channels agreed to participate, demonstrating a higher level of interest compared to those who

accessed the eligibility survey through SONA. Therefore, while SONA facilitates screening efforts, it appears ineffective at attracting genuinely interested participants.

Furthermore, once participants were onboarded to the study and attended at least one peer support group meeting, they tended to remain engaged until the program's completion. The one student who withdrew did so after the first peer support group meeting. Unfortunately, this student proved unresponsive to messages from the research team, hindering our ability to gather feedback regarding their withdrawal from the program. All other enrolled participants continued their engagement, completing TAO modules, attending peer support groups, and completing assessments. Prior studies of DMHIs for depression and/or anxiety with human support have found drop-out rates of online interventions with similar timeframes (i.e., approximately 7 to 8 weeks) to range from 15 to 27% (Goldin et al., 2019; Titov et al., 2010). Tomasino et al. (2017), a study of depressed older adults participating in a DMHI with peer networking features, had a dropout rate of 17%. The current study demonstrated higher rates of retention of participants in contrast to the above-mentioned studies, a difference likely attributed to its group component. The group format potentially fostered a sense of accountability among participants. Post-intervention feedback suggested that participants completed the modules to be able to participate in group discussions, suggesting that the collective learning environment sustained their engagement. Moreover, participants may have felt a sense of responsibility towards their fellow group members, which further incentivized consistent attendance.

TAO Module Completion and Engagement

In cases where participants had not finished all the assigned TAO modules before the peer support group meeting, they had the opportunity to troubleshoot non-adherence with the group. Group members collaboratively shared ideas to assist one another in completing the TAO

modules. In most cases, they successfully caught up and completed the TAO modules at a later date. Thus, the 95% of participants that completed at least 50% of TAO modules far surpassed our initial 60% prediction. The module completion rates in the current study are similar or superior to previous studies of DMHIs with human support. For example, Harrer et al. (2018), a study with a trained student coach, reported a module adherence rate of 74%. Day et al. (2013), another study with student coaches, found that 61% of participants completed all five assigned modules. Other studies of DMHIs did not have a support group component, but incorporated peer networking features such as "liking" or commenting on others users' activities. Ho et al. (2016) assessed the feasibility of a 10-week DMHI with peer networking features for preventing depression among adolescents. Participants had access to a total of 48 lessons, and an average of 11.3 lessons were completed. The low module completion rates in Ho et al. (2016) may be attributed to a lack of schedule, whereas participants in the present study were assigned to complete one to three modules per week. In addition, Ho et al. (2016) was primarily focused on prevention of mental health problems, rather than addressing current symptoms of depression and anxiety. Tomasino et al. (2017) implemented a digital CBT intervention with peer networking features for older adults with depression. In Tomasino et al.'s (2017) study, participants were tasked with completing two modules per week over an eight-week period. The average number of completed lessons was 11.3 out of 16 lessons. In our study, spanning a seven-week period with a total of 16 modules assigned, participants exhibited an average completion of 13.9 modules. When considering only those who remained enrolled until study completion, the average rose to 14.6 modules. While it is uncertain whether the difference in module adherence rates between our study and Tomasino et al.'s (2017) study is statistically significant, the findings suggest that a more personalized approach, such as the peer support groups in our study, may

benefit engagement. Furthermore, the group component of the current study likely enhanced the accountability of group members to complete the assigned TAO modules prior to group meetings. In the open-ended feedback provided at post-treatment, participants expressed feeling compelled to finish the modules in order to actively engage in the discussions. Hearing other group members share their experiences of perseverance in module completion and having the opportunity to collectively address adherence challenges within the group setting may have further motivated participants to stay on track.

The current study also showed promising outcomes in terms of TAO module adherence when compared to a previous study on a DMHI for social anxiety with a group component. In a study by Sigurðardóttir et al. (2022), participants placed in an experimental group, who attended psychoeducation sessions reviewing content in a slideshow format, had a module adherence rate of 9.5%. In contrast, our study achieved an average module adherence rate of 87%, notably higher than Sigurðardóttir et al. (2022). The lower completion rates in their study may be due to the didactic format of the psychoeducational sessions in the experimental group, which may have been perceived as repetitive, potentially reducing participants' motivation to independently complete the modules. The current study's success may be attributed to peer support meetings that fostered open discussions on skill application and coping strategies in daily life. Many participants reported that these discussions motivated them to complete the modules. This suggests that face-to-face group interactions between peers, whether in-person or virtually, may provide some advantages over other forms of human support.

Moreover, engagement in TAO was also measured at three and seven weeks using the Digital Behavior Change Interventions (DBCI) Engagement Scale (Perski et al., 2020), a self-report measure that was adapted for the present study to assess the user's experiences during

their most recent use of TAO. This scale was validated by Perski et al. (2020) using a sample of adults who had downloaded a mobile application focusing on alcohol reduction. In the current study, item scores for interest, intrigue, focus, and enjoyment were comparable to those of Perski et al. (2020), all surpassing the midpoint score of 4. Inattention and distraction in our study fell below the midpoint at both assessment points, whereas participants in Perski et al. (2020) exhibited potentially higher levels of inattention (5.32) and distraction (5.30) above the midpoint of 4. Additionally, the sample in Perski et al. (2020) reported levels of pleasure below the midpoint (3.63), whereas the participants in the present study reported levels of pleasure above the midpoint at both timepoints. As the DBCI Engagement Scale is a recently created measure, its use has not yet been widely disseminated to measure engagement across other DMHIs. Future studies are necessary to better understand the psychometric properties of the DBCI Engagement Scale. Nevertheless, the encouraging results from the current study suggest that participants generally experienced positive emotions and were able to sustain attention when using TAO.

Peer Support Group Attendance

Our overall group attendance was notably high, reaching 83%, and an even more impressive 87% when excluding the one participant who dropped out after the first group meeting. This attendance rate is considerably higher than comparable studies. In Sigurðardóttir et al.'s (2022) study, participants assigned to the experimental group, who were invited to attend three sessions of reviewing psychoeducational material from the DMHI, attended an average of 1.00 meetings, with roughly half of participants not attending any group sessions. Likewise, those in the placebo group, who were invited to attend three meetings involving progressive muscle relaxation practice, attended an average of 1.18 meetings, and 45% did not partake in any group sessions. The presentation format of the psychoeducational sessions in the experimental

group likely contributed to a sense of repetitiveness, potentially diminishing the incentive to attend the meetings. The underlying reasons for the low attendance in the placebo group remain unclear. However, it is worth noting that the participants in the present study noted that they found the discussion-based format to be valuable. This suggests that the prospect of engaging in group discussions about the material learned from the DHMI served as a significant motivator for both completing the modules as well as attending the group meetings.

Our groups also demonstrated higher attendance rates compared to Byrom (2018), which employed a standalone skill-based peer support group (i.e., without a DMHI) where participants were invited to attend six weekly sessions led by student volunteers. In their study, 57% of participants attended two or more group sessions, and 34% completed the entire program. It is worth nothing that unlike our study, the participants in Byrom (2018) were not screened prior to participation; they were simply invited to attend the meetings regardless of their current symptomatology. Participants in the present study underwent an initial eligibility screening, requiring them to have at least a moderate level of anxiety and/or depression symptoms before receiving an invitation to participate. Consequently, participants in our study may have exhibited more clinically significant symptoms, thereby increasing their motivation to seek mental health assistance. Additionally, participants attended an orientation session with a member of the study team to familiarize themselves with the purpose and format of the peer support group. Attendance at this orientation session was a prerequisite for study inclusion. Those who attended at least the orientation session likely demonstrated heightened motivation and commitment to attending group meetings and completing TAO modules.

Our study's attendance was lower than that of Fontana et al. (1999), which evaluated the efficacy of a peer-led stress management intervention among undergraduate students. Fontana et

al. (1999) found that the six treatment sessions were attended by all participants (N = 36), which may be due to characteristics of the sample, as the participants were undergraduate volunteers fulfilling a requirement for an introductory level psychology course. Consequently, these individuals had a strong incentive to attend. In contrast, participants in our study were not compensated for attendance but received compensation upon completion of assessments. Additionally, as Fontana et al. (1999) did not incorporate a DMHI component, participants may have been more motivated to attend sessions since the material was not readily available online. While including incentives can effectively boost attendance at peer support group meetings, such strategies are less feasible outside of controlled research settings.

Intervention Satisfaction

Participants were relatively satisfied with the TAO with peer support program. Nearly all participants reported that they did not require technical assistance when using TAO, underscoring its accessible design. This observation is noteworthy, as previous studies have identified technical challenges as an obstacle to engagement (Borghouts et al., 2021). The most frequently identified barriers to engaging in TAO were having a busy schedule, forgetting, and lack of motivation. To address these challenges, the peer support groups aimed to help students proactively plan and schedule time for TAO activities while tackling any obstacles hindering module completion. According to participants' open-ended responses, the groups served as a source of motivation. Many participants shared that they completed modules ahead of time to actively participate in group discussions.

While most participants completed the assigned TAO modules before the meetings, participants who did not complete the modules did still attend the meetings. Remarkably, even participants who did not complete all the modules or attend every meeting shared favorable

opinions of the program. These results align with prior research findings indicating that college students hold favorable attitudes towards DMHIs and are willing to use them. Notably, research suggests that more than one-third of students express a preference for DMHIs over in-person treatment (Kern et al., 2018; Levin et al., 2018; Reyes-Portillo et al., 2022). However, the challenge lies in raising awareness of DMHIs and facilitating engagement among users. In a survey conducted at the same university as the present study, where nearly half of the participants acknowledged a perceived need for mental health services, only 11% were aware of TAO, and a mere 2% had previously used it. Promoting regular mental health screenings for students, coupled with referrals to programs like TAO with peer support, could serve as an effective approach to encourage students to use DMHIs.

Another positive outcome of this study was that nearly one-third of participants either began psychotherapy in the weeks before the study ended or had scheduled an initial appointment for the weeks following the study's conclusion. This highlights the potential of TAO with peer support as an entryway to formal help-seeking behaviors, which is particularly crucial given that at seven weeks, 84% of participants still reported clinically significant anxiety and 42% reported moderate depression. Engaging in screening surveys, psychoeducational TAO modules, and peer support groups may have prompted these students to acknowledge their need for their mental health services, thereby increasing motivation to seek counseling.

Initial Efficacy

Our hypothesis that TAO with peer support would demonstrate initial efficacy, such that participants would report decreased depression and anxiety symptoms from baseline to seven weeks, was supported. Prior research on DMHIs incorporating peer support or additional group components have also demonstrated significant reductions in depression and anxiety symptoms (Sigurðardóttir et al., 2022; Tomasino et al., 2017). This is consistent with previous research that

has found an association between DMHI engagement and decreased depression and anxiety symptoms post-intervention (Gan et al., 2021). Moreover, while we did not formally hypothesize whether perceived social support would change over the course of the program, we did find that perceived social support increased over the seven-week intervention period. There is a wealth of research citing negative associations between perceived social support and internalizing symptoms. Perceived social support has also been identified as an important protective factor against depression and anxiety symptoms, particularly among college students (Reid et al., 2016; Taylor et al., 2014). Exchanging validation and feedback in the peer support groups may have improved students' perceptions of social support. Another possibility is that by learning the skills from TAO, participants were better equipped to use their own support networks.

Strengths and Limitations

One of the major strengths of this study is its innovative interventional design. While many prior studies have included aspects of human support or peer networking features, the inclusion of a peer support group was novel, capitalizing on college students' preference towards informal sources of support (Eisenberg et al., 2011; Lipson et al., 2018; Reavley et al., 2012). Another strength of the present study is the racially/ethnically diverse sample. The present study was from a Hispanic-serving institution in Northern New Jersey, one of the most diverse areas in the U.S. Half of our sample was Hispanic/Latinx, and while participants could select more than racial group, half of the sample indicated a racial background of Black, American Indian/Alaska Native, or Other. Therapy clients often express preferences to work with clinicians that are of the same race or gender (Ilagan & Heatherington, 2022), but therapist-client match is not always feasible (Ertl et al., 2019). Furthermore, lack of financial resources and concerns about cultural sensitivity are more commonly reported as barriers to treatment among racial/ethnic minority students (Horwitz et al., 2020). DMHIs are one method of providing access to information about

mental health while overcoming barriers associated with traditional therapy. The addition of a peer support group can not only improve engagement, but also increase the likelihood that students will work through their problems with other students from similar backgrounds. Furthermore, our sample exhibited a degree of diversity in terms of school year, with 55% of participants being in their first two years of college (i.e., freshmen or sophomores), and the remaining 45% comprising juniors or seniors. This type of diversity is particularly advantageous, as the more senior college students can serve as role models and share coping strategies with their junior counterparts. Thus, our study adds to the body of literature supporting mental health outcomes of a diverse body of college students.

This study examined the impact of peer support groups, conducted both in-person and via Zoom teleconferencing. In the wake of the COVID-19 pandemic, mental health practitioners quickly pivoted towards teletherapy (Taylor et al., 2020), with many continuing to provide remote services even after the easing of social distancing restrictions and improvement of the pandemic (Gangamma et al., 2022). Many college students view teletherapy as an acceptable alternative to traditional in-person therapy, citing the increased accessibility as a notable benefit (Gonzalez et al., 2022). However, many patients also express strong preferences for in-person services, citing the importance of fostering human connection through face-to-face interactions (Johnson et al., 2023) and the privacy concerns of accessing telehealth services from home (Gonzalez et al., 2022). College counseling centers may wish to consider offering a combination of virtual and in-person peer support groups, which may be dependent on the campus culture. Virtual groups may be more suitable on college campuses in which a large proportion of the students are commuters, whereas a college with a high proportion of students living on campus may benefit from more in-person options.

The current study faces several limitations that warrant consideration. Being a pilot study, we recruited a relatively small sample size, diminishing the statistical power. Notably, the sample included predominantly women comprising 70% of the sample, with only a small representation of two men (10%) and four non-binary/genderqueer (20%) students. This gender imbalance highlights a potential bias in our findings, emphasizing the need for more diverse participant recruitment to increase generalizability in future research. Furthermore, the absence of comparison groups in this study hinders us from concluding whether the high treatment adherence was solely attributed to the addition of the peer support group. Subsequent studies should include control groups for a more thorough assessment of the value of peer support groups as an engagement strategy. Moreover, the present study is unable to discern whether the support groups or the TAO modules had a greater impact on the observed improvements in depression and anxiety. Participants also demonstrated an increase in perceived social support over the duration of the study, and this improvement may have stemmed from feeling supported by others in the group, or, alternatively, a heightened awareness of existing social support networks. It is possible that participants experienced cognitive shifts in how they perceive their problems and resources, rather than an actual change in social support. Further research should utilize study designs that clarify the individual contributions of peer support groups and TAO to mental health outcomes.

The lower-than-expected enrollment rates may be attributed to our recruitment methods, specifically the use of the SONA participant pool for screening eligible participants. Given that students are mandated to fulfill SONA credits as part of their coursework, their motivation to engage in a study that would not provide them with additional SONA credits may have been low. Additionally, the time commitment required for participation could have deterred some students

from enrolling. Notably, the initial three groups were conducted in person. While some students indicated interest, logistical constraints such as scheduling conflicts and off-campus obligations prevented some eligible students from participating. When virtual meetings were later proposed as an alternative, several of these initially interested students were no longer available or did not respond to our inquiries.

Implications and Directions for Future Research

This study highlights the potential efficacy of implementing a DMHI with evidence-based approaches for managing depression and anxiety while incorporating a peer support group to discuss the utilization of these coping strategies. Delegating the psychoeducational component to a DMHI not only eases the workload on mental health professions but also affords users the flexibility to revisit the modules. The integration of a peer support group further enhances the program, fostering a sense of accountability and solidarity among participants, while also serving as a platform for addressing questions and sharing insights. The implementation of TAO, a transdiagnostic digital intervention freely accessible to all students and faculty across various institutions in the U.S., exemplifies a scalable model that holds promise for adoption in higher education institutions nationwide.

Our findings offer support for established theories. Participant feedback indicated that students effectively learned from each other, aligning with the principles of Social Learning Theory (Bandura, 1977). Notably, participants shared insights on time management strategies to complete TAO and offered guidance on applying skills to address problems and cope with stressors. This resonates with previous research emphasizing that college students often seek informal support from peers before seeking professional help for mental health challenges (Eisenberg et al., 2011; Lipson et al., 2018; Reavley et al., 2012). Consistent with Social Impact Theory, the results suggest that college students learned adaptive health behaviors from one

another due to their shared characteristics, proximity in space and time (especially during on-campus meetings), and exposure to information from multiple peers simultaneously, thereby enhancing the perceived validity of such information. Importantly, several students noted that completing TAO alongside peers facing similar struggles and progressing through the modules concurrently was particularly beneficial. This collaborative aspect contributed to a supportive and validating environment during the intervention.

The next phase of this research calls for a pivot towards appraising the feasibility of recruiting and training undergraduate students to assume the role of peer leaders for the support groups. If these interventions prove effective in ameliorating participants' depression and anxiety, there lies the potential for participants or other motivated college students to step into the role of a group leader, aiding others in completing the program and acquiring coping skills. It is imperative for future investigations to evaluate the implementation fidelity of undergraduate students as facilitators of peer support groups, marking a crucial stride in enhancing treatment accessibility and alleviating the workload on mental health professionals within university settings.

Conclusion

This pilot study offered valuable insights into the feasibility, acceptability, and initial efficacy of using a brief peer support group as an engagement strategy for DMHIs. While enrollment was lower than predicted, participants in the program were engaged and responded favorably to the intervention. The significant decreases in depression and anxiety from baseline to post-treatment demonstrate potential for further research that can expand our understanding on how to harness peer support to enhance DMHI engagement. Future work can focus on efforts to

improve enrollment and scalability of TAO with peer support to expand treatment accessibility for college students.

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Tables

Table 1

Demographic Characteristics of Sample at Baseline

	Number	%
Sex Assigned at Birth		
Female	18	90%
Male	2	10%
Gender		
Man	2	10%
Woman	14	70%
Genderqueer/Gender Fluid/Non-binary	4	20%
Race (Select all that apply)		
Black	6	30%
White	12	60%
American Indian/Alaska Native	1	5%
Asian	0	0%
Native Hawaiian/Pacific Islander	0	0%
Other	3	15%
Ethnicity		
Hispanic/Latinx	10	50%
Not Hispanic/Latinx	10	50%
Student Year		
Freshman	9	45%
Sophomore	2	10%
Junior	7	35%
Senior	2	10%
Commuter Status		
Live on Campus	11	45%
Commuter	9	55%
Enrollment Status		
Full-Time	19	95%
Part-Time	1	5%
Federal/State Financial Assistance		
Yes	16	80%
No	3	15%
Prefer not to disclose	1	5%

Note. This table presents demographic characteristics of the full sample (N = 20) at baseline.

Table 2

Recruitment and Intervention Engagement

	Number	
Recruitment		
Participants screened	661	
Eligible	233	
Agreed to participate	20	
Remained enrolled	19	
Completed at least 50% of TAO modules	19	
	M (SD)	**Total %**
Peer Support Groups Attended		
All participants (N = 20)	4.95 (1.15)	83.33%
Participants that remained enrolled (n = 19)	5.16 (0.69)	86.84%
TAO modules completed (out of 16)		
All participants (N = 20)	13.85 (3.65)	86.56%
Participants that remained enrolled (n = 19)	14.58 (1.68)	91.12%
	Number	**%**
Devices used to access TAO (Select all that apply)		
Computer	14	73.70%
Tablet	2	10.50%
Smartphone	12	63.20%

Table 3

Technology Use at Baseline

Measure	Number	%
Smartphone ownership		
Yes	20	100%
No	0	0%
Top 3 apps you like to use on your smartphone		
Instagram	11	55%
TikTok	11	55%
Spotify	5	25%
Messages	5	25%
Twitter	4	20%
YouTube	3	15%
Discord	2	10%
E-mail	2	10%
Facebook	2	10%
Pinterest	2	10%
Internet Browsers	2	10%
Blog-based platforms	2	10%
FaceTime	1	5%
Netflix	1	5%
Health/fitness tracker	1	5%
Reading apps	1	5%
Other games	3	15%
	M (SD)	**Range**
Hours per day spent using apps		
Facebook	0.30 (0.66)	0-2
Instagram	2.75 (1.92)	0-8
Twitter	1.15 (1.84)	0-7
TikTok	2.95 (3.27)	0-10
Snapchat	0.65 (0.93)	0-3
Tumblr	0.40 (1.57)	0-7
YouTube	1.95 (1.57)	0-6
Pinterest	1.05 (1.32)	0-5
Forums	0.45 (1.00)	0-4
Messaging apps	2.05 (2.50)	0-9
Email	2.30 (2.41)	0-7
Texting	2.95 (2.95)	0-10
Dating sites/apps	0.25 (0.55)	0-2
Sports/fighting/racing games	0.25 (0.72)	0-3
Other video games	1.55 (2.70)	0-10

Note. $N = 20$

Table 4

Mental Health Attitudes and Service Utilization at Baseline

Measure	M (SD)	
Most people think less of a person who has received mental health services. *1 = Strongly Agree* *6 = Strongly Disagree*	2.95 (1.23)	
I would think less of a person who has received mental health treatment. *1 = Strongly Agree* *6 = Strongly Disagree*	5.60 (0.68)	
In the past 12 months, I needed help for emotional or mental health problems such as feeling sad, blue, anxious, or nervous. *1 = Strongly Agree* *6 = Strongly Disagree*	1.90 (0.85)	
I currently need help for emotional or mental health problems such as feel sad, blue, anxious, or nervous. *1 = Strongly Agree* *6 = Strongly Disagree*	2.55 (0.95)	
	Number	**%**
Have you ever received counseling or therapy for mental health concerns?		
No, Never	12	60%
Yes, prior to starting college	6	30%
Yes, since starting college	1	5%
Yes, both of the above	1	5%
Prefer not to disclose	0	0%
How many total visits or sessions for counseling or therapy have you had in the past 12 months?		
0	14	70%
1-3	3	15%
4-6	1	5%
7-9	1	5%
10 or more	1	5%
Prefer not to disclose	0	0%
In the past 12 months, which of the following factors have caused you to receive fewer services (counseling, therapy, or medications for your mental or emotional health than you would have otherwise received? (Select all that apply)		
No need for services	2	10%
Financial reasons (too expensive, not covered by insurance)	9	45%
Not enough time	9	45%
Not sure where to go	8	40%
Difficulty finding an available appointment	4	20%
Prefer to deal with issues on my own or with support from family/friends	9	45%
Other	2	10%
No barriers	0	0%
Prefer not to disclose	0	0%

In the past 12 months, which of the following explain why you have not received medication or therapy for your mental or emotional health? (Select all that apply)		
I haven't had the chance to go but I plan to	5	25%
No need for services	2	10%
Financial reasons (too expensive, not covered by insurance)	4	20%
Not enough time	7	35%
Not sure where to go	3	15%
Difficulty finding an available appointment	3	15%
Prefer to deal with issues on my own or with support from family/friends	6	30%
Other	3	15%
No barriers	0	0%
Prefer not to disclose	0	0%

Note. $N = 20$

Table 5

Peer Support Group Meetings

Group Start Date	Number of Group Leaders	Number of Participants at Baseline	Number of Participants Enrolled at Last Meeting	Format	Average Implementation Fidelity (%)	Average Number of Meetings Attended per Participant
2/22/2023	2 (EK and AU)	5	5	In-person	97.2%	4.8
3/20/2023	1 (EK)	4	4	In-person	97.2%	5.0
3/27/2023	2 (EK and BJ)	3	3	In-person	94.4%	4.7
4/14/2023	1 (EK)	3	3	Zoom	100%	5.3
4/26/2023	1 (EK)	5	4	Zoom	100%	5.0*

Note. EK = Principal Investigator; AU and BJ = undergraduate research assistants. The PI was present at all group meetings. Implementation fidelity was calculated according to the Fidelity Checklist in Appendix 3.

*Group 6 averaged 6.0 meetings when excluding the one participant who dropped out of the study.

Table 6

Digital Behavior Change Interventions (DBCI) Engagement Scale

Please answer the following questions with regards to your most recent use of the TAO modules.	**3-Week Survey**		**7-Week Survey**	
How strongly did you experience the following? ***1 = Not at all to 7 = Extremely***	**M (SD)**	**Range**	**M (SD)**	**Range**
Interest	5.16 (1.30)	3–7	5.32 (1.00)	4–7
Intrigue	5.00 (1.53)	2–7	5.32 (1.25)	3–7
Focus	4.53 (1.71)	2–7	4.84 (1.21)	3–7
Inattention	3.11 (1.37)	1–6	3.33 (1.03)	1–5
Distraction	3.32 (1.89)	1–7	3.32 (1.25)	1–6
Enjoyment	5.05 (1.22)	3–7	5.37 (1.34)	2–7
Pleasure	5.00 (1.37)	2–7	5.47 (1.17)	3–7
Annoyance	2.53 (1.84)	1–7	2.16 (1.21)	3–7

Note. This table presents measurement of the sample of participants who completed assessments at three and seven weeks (n = 19).

Table 7

Acceptability (7 weeks)

Item	M (SD)
To what extent has TAO with peer support helped improve your depression/anxiety symptoms? *1 = Not at all* to *5 = Extremely*	3.21 (0.79)
To what extent has TAO with peer support improved your overall situation? *1 = Not at all* to *5 = Extremely*	3.32 (0.95)
How satisfied are you overall with the online intervention plan? *1 = Not at all* to *5 = Extremely*	3.84 (0.69)
How satisfied are you overall with participating in this study? *1 = Not at all* to *5 = Extremely*	4.26 (0.73)
How easy is it to use TAO? *1 = Not at all* to *5 = Extremely*	4.58 (0.84)
How easy was TAO to navigate? *1 = Not at all* to *5 = Extremely*	4.58 (0.77)
How willing were you to complete TAO modules? *1 = Not at all* to *5 = Extremely*	3.89 (0.81)
How much did the e-mail reminders help you to complete TAO modules? *1 = Not at all* to *5 = Extremely*	4.47 (0.91)
How much did the peer support group help you to complete TAO modules? *1 = Not at all* to *5 = Extremely*	4.00 (1.11)
How helpful was the peer support group in coping with your depression or anxiety? *1 = Not at all* to *5 = Extremely*	4.00 (0.94)
How willing were you to attend the peer support group? *1 = Not at all* to *5 = Extremely*	4.47 (0.51)
How likely is it that you would recommend TAO with peer support to a friend? *1 = Not at all* to *5 = Extremely*	4.05 (0.91)
If you previously received counseling or therapy before starting TAO with peer support, how effective was it in addressing your mental health concerns? (*n* = 7) 1 = *Not at all effective* to 4 = *Extremely effective*	2.14 (0.90)
	Number (%)
Was technical support available for TAO when you needed it?	
Never or rarely	1 (5.3%)
Some of the time	0 (0%)
Most or all of the time	0 (0%)
I did not need technical support for TAO	18 (94.7%)
What factors interfered with your engagement with the TAO modules (Select all that apply)	
Busy schedule	17 (89.4%)
Lack of motivation	10 (52.6%)
Forgetting to complete the modules	11 (57.9%)
Technical issues (E.g., app crashes, difficulty connecting to Wifi)	1 (5.3%)
Privacy/confidentiality concerns about TAO	0 (0%)
The information provided by TAO was not relevant to my situation	0 (0%)
Difficulty finding the assigned modules on TAO	0 (0%)
Other	0 (0%)
Not applicable	0 (0%)
Started receiving therapy for mental health concerns?	6 (31.6%)

Note. This table presents measurement of the sample of participants who completed assessments at seven weeks (*n* = 19).

Table 8

Depression, Anxiety, and Perceived Social Support at Baseline, Three Weeks, and Seven Weeks

Measure	M (SD)	Range	t, df, *p*-value	Cohen's d	95% CI
Depression (PHQ-8)			2.72, 18, .014*	.63	[.12, 1.11]
Baseline	12.00 (4.08)	[6, 17]			
3-Week	10.74 (5.26)	[3, 19]			
7-Week	8.79 (4.84)	[0, 18]			
Anxiety (SCAARED)			2.53, 18, .021*	.58	[0.09, 1.06]
Baseline	50.53 (15.74)	[25, 83]			
3-Week	46.05 (14.32)	[18, 68]			
7-Week	39.74 (14.81)	[18, 65]			
Perceived Social Support (SPS)			-3.32, 18, .004**	-.76	[-1.27, -.24]
Baseline	68.84 (10.45)	[46, 95]			
3-Week	71.58 (10.32)	[56, 96]			
7-Week	74.68 (7.77)	[63, 93]			

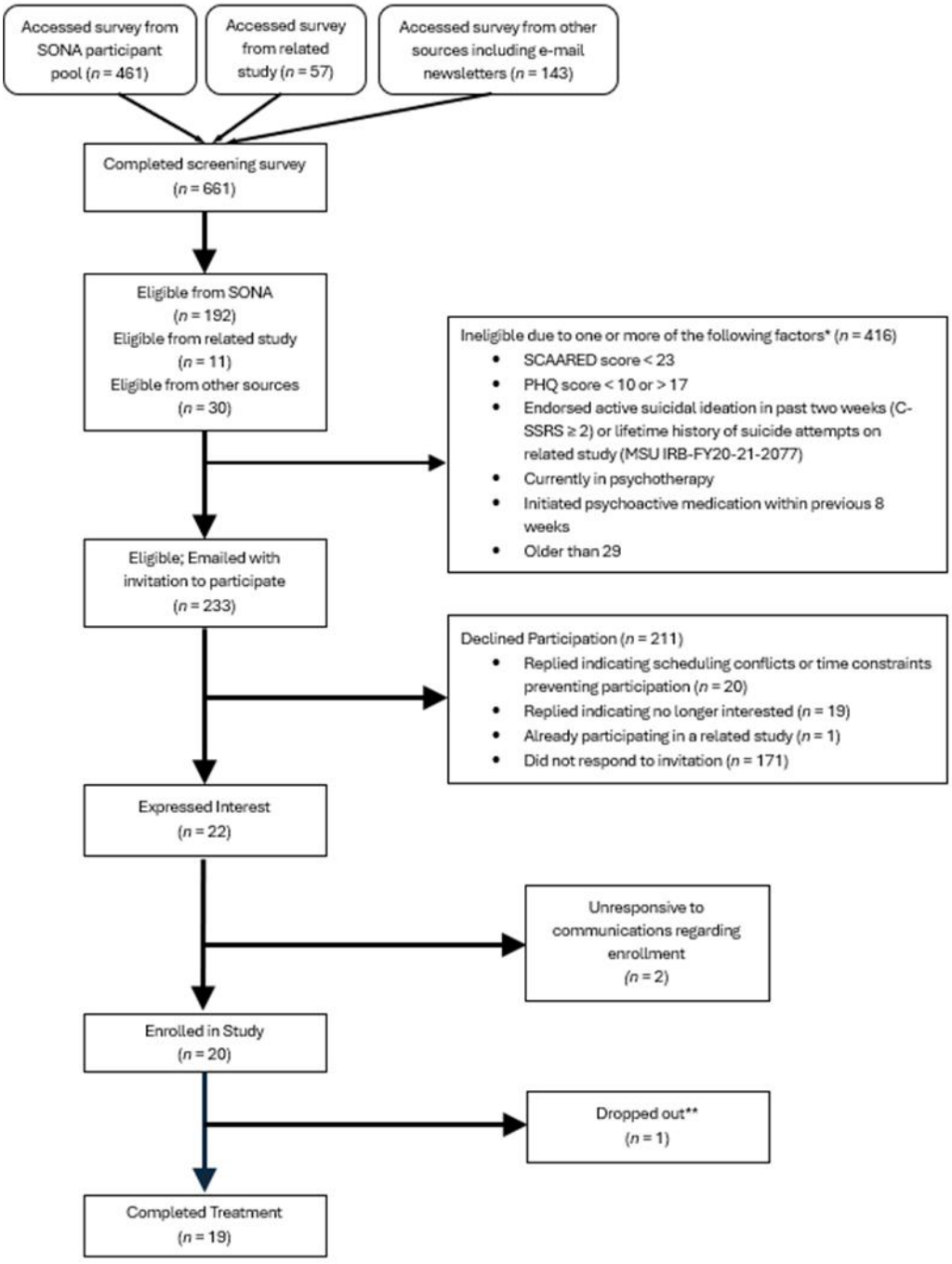
Note. This table presents measurements of the sample of participants who completed assessments at each designated time point (n = 19). Cohen's d values of ±0.20 are considered small effects, values ±0.50 are considered medium effects, values ±0.80 or greater are considered large effects.

* $p < .05$; ** $p < .01$

Figures

Figure 1

Recruitment Flowchart



*Participants were excluded due to meeting one or more exclusion criteria

**One participant was considered a drop-out as they did not attend any peer groups after the first meeting, did not complete the 3-week and 7-week assessment, and did not respond to communications from the study team.

Appendix 1

Timepoint	TAO Module Assigned	Peer Support Group	Assessments
Week 0: Enrollment in Study	1. Sources of Well-Being (10 min) 2. Recognizing Depression TRAPS (10 min) 3. What is Anxiety? (10 min)	None	Baseline Survey
Week 1	1. Improving Awareness and Understanding (15 min) 2. Activation Plan (15 min) 3. Causes of Anxiety and Unhelpful Practices (15 min)	Meeting 1	
Week 2	1. Road Map for Activation (10 min) 2. BA: Values (10 min) 3. ACT: Mindfulness (20 min)	Meeting 2	
Week 3	1. TRAPS (20-30 min) 2. Deep Breathing (10 min)	Meeting 3	Week 3 Survey
Week 4	1. TRAC (15-20 min) 2. Problems (20-30 min)	Meeting 4	
Week 5	1. BA: Thinking Habits (15-20 min) 2. Facing Fears (15 min)	Meeting 5	
Week 6	1. Review and Reflect (30-45 min)	Meeting 6	
Week 7	None	None	Week 7 Survey

Appendix 2

Meeting	Activities
Meeting 1	• Welcome and establishing group guidelines (10 minutes) • Complete consent forms, confidentiality forms, and baseline survey (15 minutes) • Register TAO account (5 minutes) • Sharing of wellness goals (5 minutes) • Identifying and troubleshooting barriers (10 min) • Setting goals for TAO completion and reminders about assigned modules (5 minutes)

Meeting 2	• Welcome (5 minutes)
	• Identifying successes and challenges in completing TAO and troubleshooting non-adherence (5 minutes)
	• Psychoeducational review and group discussion of using TAO skills (30 minutes)
	  ○ **Sources of Well-Being:** Peer leaders review how finding meaningful activities and social support relate to well-being and prompt group members to share what they've noticed about the relationship between their mood and how active they were.
	  ○ **Recognizing Depression TRAPS:** Peer leaders review how to increase awareness of vulnerabilities to depression. Group members are encouraged to share examples of their triggers for depression and whether their lives are balanced between the amount of positive and negative regular experiences
	  ○ **What is Anxiety?:** Leader review the physiological symptoms of anxiety and observing how, when, and where anxiety occurs in our lives. Group members are encouraged to identify examples of mild and problem anxiety in their lives.
	  ○ Group members share advice and feedback on how to apply TAO skills to problem-solve and cope with stressors
	• Setting goals for TAO completion and reminders about assigned modules (5 minutes)

Meeting 3	• Welcome (5 minutes)
	• Identifying successes and challenges in completing TAO and troubleshooting non-adherence (5 minutes)
	• Psychoeducational review and group discussion of using TAO skills (30 minutes)
	  ○ **Improving Awareness and Understanding**: Peer leaders review how writing down emotional reactions helps us to be more aware and to notice patterns in order to know what to change in our routine to improve our mood.
	  ○ **Activation Plan**: Leaders review how to create an activation schedule using enjoyable activities and achievable tasks.
	  ○ **Causes of Anxiety and Unhelpful Practices**: Leaders review how to differentiate helpful and unhelpful anxiety, identifying how past experiences have influenced present behavior and attitudes, and recognizing recurring themes of anxiety.
	  ○ Group members share advice and feedback on how to apply TAO skills to problem-solve and cope with stressors
	• Setting goals for TAO completion and reminders about assigned modules (5 minutes)

Meeting 4	• Welcome (5 minutes)
	• Identifying successes and challenges in completing TAO and troubleshooting non-adherence (5 minutes)
	• Psychoeducational review and group discussion of using TAO skills (30 minutes)
	  ○ **Road Map for Activation:** Peer leaders review strategies to help complete your activation plans, including how to make goals "SMART", limiting distractions, and pairing less enjoyable activities and more enjoyable activities.
	  ○ **Values**: Leaders review how to recognize what members find meaningful in their lives, and whether their current routine is in line with their values.
	  ○ **Mindfulness**: Leaders review what mindfulness is and how being in the present moment can help you accurately perceive situations and choose value-based actions.
	  ○ Group members share advice and feedback on how to apply TAO skills to problem-solve and cope with stressors
	• Setting goals for TAO completion and reminders about assigned modules (5 minutes)

Meeting 5	• Welcome (5 minutes)
	• Identifying successes and challenges in completing TAO and troubleshooting non-adherence (5 minutes)
	• Psychoeducational review and group discussion of using TAO skills (30 minutes)
	  ○ **TRAPS:** Peer leaders review how triggering events result in thoughts, feelings, and avoidance behaviors and encouraged group members to identify their triggers and avoidance patterns.
	  ○ **TRAC:** Peer leaders review how to respond to triggers using alterative coping strategies that are consistent with one's long-term goals and values.
	  ○ **Deep Breathing:** Leaders reviewed how deep breathing exercises can help members quickly destress and calm down.
	  ○ Group members share advice and feedback on how to apply TAO skills to problem-solve and cope with stressors
	• Setting goals for TAO completion and reminders about assigned modules (5 minutes)

Meeting 6	• Welcome (5 minutes)
	• Identifying successes and challenges in completing TAO and troubleshooting non-adherence (5 minutes)
	• Psychoeducational review and group discussion of using TAO skills (30 minutes)
	  ○ **Problems:** Leaders reviewed how to apply the problem solving model by breaking problems into four basic steps.
	  ○ **Thinking Habits:** Peer leaders review how to increase awareness of rumination and change thinking habits and behaviors to reduce the amount of time spent ruminating.
	  ○ **Facing Fears:** Leaders review how facing our fears lowers anxiety in the long-term and prompt group members to identify feared situations that they can face.
	  ○ Group members share advice and feedback on how to apply TAO skills to problem-solve and cope with stressors
	• Reflection on wellness goals, share goals for finishing TAO, and reminders about assigned modules (10 minutes)

Appendix 3

Peer Support Group Fidelity Checklist

_____ Session number _____ Peer leader(s) initials

__/__/__ Date of Session _____ Rater initials

Session 1	**Non-adherent**	**Adherent**
Peer leader(s) prompt group members to share wellness goals.	0	1
Peer leader(s) guide group members in identifying potential obstacles that may hinder successful completion of TAO modules.	0	1
Peer leader(s) facilitate group members in generating solutions and strategies for successful TAO completion.	0	1
Peer leader(s) reminded group members of assigned TAO modules for upcoming week.	0	1
Sessions 2 – 6	**Non-adherent**	**Adherent**
Peer leader(s) invited group members to reflect on successes and challenges in progressing in the previous week's goals and completing TAO.	0	1
If one or more group member(s) have not completed TAO module assignments, peer leader(s) encourage group members to help troubleshoot non-adherence. *(If everyone completed TAO, then score as 1)*	0	1
Peer leader(s) facilitated review of information from TAO modules assigned in previous week.	0	1
Peer leader(s) facilitated validation of challenges and successes and/or prompted group members to share advice/feedback on how to apply TAO skills to problem-solve and cope with stressors.	0	1
Peer leader(s) prompted group members to share goals for completing TAO and using skills in upcoming week.	0	1
Peer leader(s) reminded group members of assigned TAO modules for upcoming week.	0	1