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An Investigation into College Students' Preferences for Technology Integration into Mindfulness-based Stress Reduction

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Abstract:

This study investigates if college students in general and those with stress, depression, and anxiety in particular would use technology to reduce their stress via mindfulness-based training. We conducted two studies. The first study focused on how college students who struggle with stress, depression, and anxiety view mindfulness-based stress reduction and using technology to support it. We conducted a survey that assessed how college students rated a variety of technologies that they could use to enhance their mindfulness-based stress reduction. The second study focused on whether college students with and without mental health issues would prefer to use an app in their mindfulness training. The first study involved 81 U.S. college students from 18 to 27 years old, and the second involved nine college students over 18 years old who had experienced stress, depression, and anxiety. The results suggest that college students did not differ in the likelihood that they would use different technologies to reduce their stress via mindfulness-based training. A majority of participants who struggled with stress, depression, and anxiety and who had taken mindfulness-based stress reduction training believed that having a mindfulness-based stress reduction app in conjunction with the in-person class we offered would reduce barriers to practicing mindfulness-based stress reduction. While many companies and technologists tout the benefits of pure online or digital solutions to mindfulness practice, the college students who struggled with stress, depression, and anxiety in our study clearly signaled that they did not prefer a technology solution alone and that they found such a solution insufficient.

Keywords: Mindfulness, Depression, Anxiety, Stress, Technology and Students.

Matthew Jensen was the accepting senior editor for this paper.

1 Introduction

Mental health issues' prevalence and complexity and the need to treat and provide support services to people with them represent growing concerns on college campuses (Center for Collegiate Mental Health, 2015; Gallagher, 2015). Almost half of college students in the United States have had a psychiatric disorder in the past year, and college counseling centers have continuously reported that the severity of mental health concerns and the number of students with significant mental health conditions have increased (Center for Collegiate Mental Health, 2015; Gallagher, 2015; Reetz, Bershad, LeViness, & Whitlock, 2016). Data from the Center for Collegiate Mental Health shows that students have reported increased distress (particularly depression, anxiety, social anxiety, self-harm, suicidal ideation, and suicidal attempts) (Center for Collegiate Mental Health, 2015). Further, in 2016, the American College Health Association surveyed 33,512 students and found that 38.2 percent reported feeling "so depressed it was difficult to function", 42.7 percent experienced "more than average stress", and 60.8 percent felt "overwhelming anxiety" (American College Health Association, 2017). College counseling centers identify anxiety and depression as the primary concerns that college students present (Center for Collegiate Mental Health, 2015; Reetz et al., 2016).

While early studies found that as few as 25 percent of students with mental disorders seek treatment, the demand for mental health services continues to grow (American College Health Association, 2017; Center for Collegiate Mental Health, 2015). In 2015, the Center for Collegiate Mental Health reported that, over five years, "the average level of counseling center utilization grew by 30%, while the average institutional enrollment grew by only 5%" (Center for Collegiate Mental Health, 2015). Counseling center directors have expressed concern with a growing demand for services without an appropriate increase in resources (Gallagher, 2015). Furthermore, while more students seek out and use mental health services, the majority of students with mental health problems still do not receive treatment (Ketchen Lipson, Gaddis, Heinze, Beck, & Eisenberg, 2015). As such, we appear to need additional professional, evidence-based services that not only address the gap between demand and resources but also certain barriers to care, such as lack of time, lack of perceived need for help, financial constraints, stigma, skepticism, and lack of awareness of resources (Eisenberg, Golberstein, & Gollust, 2007; Givens & Tjia, 2002; Hunt & Eisenberg, 2010).

Mindfulness training represents a promising approach to help college students with mental health conditions manage the stress of college life, which can overwhelm them and impede their academic achievement and social adjustment. Mindfulness refers to intentionally cultivating nonjudgmental awareness of physical sensations, thoughts, and emotional states as they arise in the present moment (Kabat-Zinn, 2003). In particular, in this study, we consider the mindfulness-based stress reduction (MBSR) program that Jon Kabat-Zinn, an American professor of medicine, developed as a clinical intervention to help patients cope with stress, pain, and illness and that has since spread around the world. Studies on the program's efficacy, feasibility, and acceptability to treat stress, depression, and anxiety in adults and younger people, support its implementation as an intervention with college students (Hoge et al., 2013; Khoury et al., 2013). Further, a 2014 meta-analysis concluded that MBSR and its derivatives could effectively reduce depression, anxiety, and pain symptoms, and other evidence supports clinically significant reductions in stress and enhanced self-efficacy and wellbeing (Grossman, Niemann, Schmidt, & Walach, 2004; Khoury et al., 2013). Mindfulness enhances self-regulation through effects on attention, emotion regulation, and self-awareness (Hölzel et al., 2011; Loucks et al., 2015). Specifically, improved attention and emotion regulation reduces individuals' stress reactivity and enhances their self-efficacy to adhere to goals, and enhanced self-awareness improves individuals' self-monitoring ability and ability to identify stress sources.

MBSR, a group-format program, comprises eight weekly classes that last for around 2.5 hours and one all-day retreat (Kabat-Zinn, 2013). The course teaches mindfulness meditation through "formal" and "informal" methods. The "formal" methods include body scan meditations, gentle hatha yoga, sitting meditations, and walking meditations. The "informal" practices involve cultivating mindfulness in everyday life through the awareness of pleasant and unpleasant events, breathing, and routine activities. The program also incorporates daily home practice assignments and a dialogue and inquiry component that explores "hindrances to mindfulness and development and integration of mindfulness-based self-regulatory skills and capacities" (Santorelli, 2014, p. 4).

2 Literature Review

Researchers have predominantly examined the efficacy of mindfulness with adult subjects. However, as the Institute of Medicine has concluded, we need to establish evidence for the efficacy of interventions with

young adults as well (Bonnie, Stroud, & Breiner, 2015). Researchers have expressed significant enthusiasm for MBSR's potential to benefit younger populations: they have found promising preliminary evidence for its effectiveness in school-based programs but emphasized the need for more rigorous studies (Greenberg & Harris, 2012). Researchers have also found evidence that younger populations, such as adolescents who had HIV or a high risk of contracting it (Sibinga et al., 2011) and young people with heterogeneous diagnoses in an outpatient psychiatric treatment facility, find MBSR acceptable (Baer, 2003). Baer (2003) in particular found a similar MBSR completion rate (i.e., 78%) for her MBSR trial with younger people compared to the completion rate that adult MBSR trials have found.

Mindfulness provides a buffer against the stress and other problems that college students experience, such as excessive alcohol consumption, binge eating, poor sleep quality, and insufficient physical activity (Bodenlos, Noonan, & Wells, 2013; Roberts & Danoff-Burg, 2010; Sibinga et al., 2011). In their metanalysis of MBSR and related interventions with college students, Regehr, Glancy, and Pitts (2013) found that they effectively reduced anxiety and had secondary effects on depression and cortisol response. These findings suggest that MBSR represents a desirable and feasible intervention to reduce stress, anxiety, and depression in college students with mental health conditions.

Since college students today are “digital natives”—individuals who have grown up in a world where electronic technology has always been a part of their lives—adding a technology component to MBSR training seems appropriate (Prensky, 2001). Eighty-six percent of college students use smartphones, 52 percent own a tablet, and 89 percent use laptops on a regular basis (Poll, 2015). Further, college students typically have 25 apps installed on their smartphone and use social media apps primarily (47.25%) followed by mail and messaging apps (14.57%), game apps (7.25%), and Web-browsing apps (4.35%) (Jesse, 2015). Colleges have started capitalizing on the fact that their students frequently use their mobile devices by incorporating campus information and safety alerts via smartphones apps as well (Negrea, 2014). In addition, college students spend a significant amount of time on their smartphones (i.e., up to eight to 10 hours a day according to one report) (Roberts, Yaya, & Manolis, 2014). Thus, the pervasiveness of the Internet makes a mindfulness intervention more easily accessible, available (24/7), anonymous, and less costly, which many people (including college students) prefer (Anderson & Titov, 2014; Wahbeh, Svalina, & Oken, 2014; Cuijpers, Marks, van Straten, Cavanagh, Gega, & Anderson, 2009).

A growing technology sector has taken notice and begun to focus on mental health apps to help young adults cope with eating disorders, anxiety, and depression. The lack of mental health insurance and long wait times for seeing a therapist have made online therapy and therapy bots a more appealing option for younger adults, who, again, habitually do things via their smartphone. In fact, Britain's National Health Service now encourages doctors to prescribe treatment via an app for teens who struggle with depression (Grothaus, 2014). Further, some research supports Internet-based therapies' effectiveness as well (Andersson, Cuijpers, Carlbring, Riper, & Hedman, 2014). However, many current “mindfulness” apps do not clearly describe the supporting philosophy, practice, and education of mindfulness (Fish, Brimson, & Lynch, 2016; Mani, Kavanagh, Hides, & Stoyanov, 2015; Lewis & Wyatt, 2014; Mohr, Cheung, Schueller, Brown, & Duan, 2013). In contrast, MBSR, the only evidence-based practice on mindfulness, does.

To date, research has shown online mindfulness-based interventions to reduce psychological distress, such as anxiety and depression, and improve quality of life for a wide variety of individuals, including healthy populations (Chiesa & Serretti, 2009; Khoury, Sharma, Rush, & Fournier, 2015) those with mental disorders (Chiesa & Serretti, 2011; Klainin-Yobas, Cho, & Creedy, 2012; McCarney, Schulz, & Grey, 2012; Piet & Hougaard, 2011; Strauss, Cavanagh, Oliver, & Pettman, 2014; Vøllestad, Nielsen, & Nielsen, 2012), and those with chronic somatic symptom disorder (SSD) (Abbott et al., 2014; Bohlmeijer, Prenger, Taal, & Cuijpers, 2010; Cramer, Lauche, Paul, & Dobos, 2012; Lauche, Cramer, Dobos, Langhorst, & Schmidt, 2013; Ledesma & Kumano, 2009; Piet, Wurtzen, & Zachariae, 2012; Veehof, Oskam, Schreurs, & Bohlmeijer, 2011; Zainal, Booth, & Huppert, 2013). However, as Spijkerman, Pots, and Bohlmeijer (2016) note, “research exploring the effectiveness of online MBIs [mindfulness-based interventions] is still in its infancy” (p. 111).

Additionally, few studies have focused on MBSR or student populations in particular. Several studies have included students in their larger pool of participants (Cavanagh et al., 2013; Glück & Maercker, 2011; Mak, Chan, Cheung, Lin, & Ngai, 2015), but they also include employees. Thus, we see a gap and need to understand if and how a MBSR app can engage young adult college students with mental health conditions.

Thus, we collected data from college students to identify specific technologies that young adult college students with mental health conditions perceive as acceptable and would be willing to use in a MBSR

program. Since young adults are more likely than older adults to drop out of psychosocial interventions and may have difficulty maintaining motivation to complete an eight-week class, enhancing MBSR with technology may increase its appeal to young adults and improve retention, adherence, and persistence post intervention (Edlund et al., 2002). The long-term goal of this research is to integrate technology into evidence-based mindfulness interventions to make those interventions more tailored to the needs of young adults.

3 Method

In order to investigate whether college students in general and those with stress, depression, and anxiety in particular would use technology in their (MBSR) training, we conducted two studies collect data directly from the population of interest—college students. The first study focused on their willingness to use the technology and the second on their preferred supportive technology—an app—in MBSR training. The first author's institutional review board approved both studies.

3.1 Study 1

3.1.1 Participants

We need to understand how college students in general feel about specific technologies as they relate to MBSR in addition to those who specifically struggle with stress, depression, and anxiety. Because people who struggle with mental health issues can feel stigmatized and ostracized due to their struggles, it can benefit them to know that “others” would also be willing to use the same technology since it can remove the stigma of use and increase acceptance (Thorncroft et al., 2016). In order to understand how college students in general and those who struggle with stress, depression, and anxiety view MBSR and using technology to support it, we conducted a survey to assess how they rated a variety of technologies that they could use to enhance MBSR (e.g., apps, online exercises, videos, online delivery of the intervention). We sent an initial online (email, Twitter, and Facebook) call for participants to students at a university in the Northeastern United States. In the call, we encouraged the students to follow a link to the survey and to forward the call to other students (friends and family) who might be interested in filling it out as well. As a result, we obtained some responses from other university students from around the United States. We enforced only one criterion: that participants be college students 18 years or older. Of the 129 visits to the survey, 81 college students (a 62.79% response rate) from 19-27 years old and who had varying majors from universities around the United States completed the short survey that asked their views on mindfulness practices and their thoughts on technology, such as social media and mobile apps, that might be helpful to young adults in MBSR training. Of the 81 completed surveys, 46 responded “yes” to struggling with “depression, anxiety, chronic pain/illness, overwhelming stress, or some other condition or challenge?”, while 35 indicated that they did not struggle with at least one of these issues. Table 1 summarizes respondents' demographic information; however, we did not collect race and ethnicity data.

3.1.2 Materials and Procedures

The first part of the survey asked participants to answer some demographic questions, including information about their age, major, university, and mental health struggles (see Table 1). The second part asked about their familiarity with mindfulness-based practices. The survey showed all participants a two-minute video snippet of Jon Kabat-Zinn introducing MBSR in order to ensure all respondents understood what MBSR involved. The subsequent multiple-choice questions focused on participants' thoughts on pairing technology with MBSR training. We developed the pairing options through several discussions with college students and MBSR specialists who considered a variety of online and social media tools and, ultimately, selected five plausible options (see Table 2). As such, we thought the online tools in Table 2 to be the most supportive given their ability to offer inspirational messaging and individual online group support. The survey also provided participants with space to add additional options if they felt that we missed any. Some of the questions included “If you had access to a mindfulness application on a personal device such as Smartphone, iPod, tablet, etc. would you download and use it?”, “If there were Facebook groups dedicated to mindfulness, would you want to be a part of these groups, so you could connect with other like-minded people?”, and “If there were a virtual living room / chat room to talk with others about mindfulness, would you visit it?”. We used a four-point Likert scale for these items with the anchors “I would use it” (1), “I would probably use it” (2), “I would probably not use it” (3), and “I would definitely not use it” (4). Finally, the survey asked participants: “Do you intend to utilize any of the technologies mentioned in this survey in the future?”

Check all that apply.”. (Readers can obtain a copy of the survey questions from the first author.) We used descriptive statistics to analyze the data.

Table 1. Demographics

Demographic	Result
Age mean	21.06 years old
Age range	19-27 years old
Gender	82% women
Majors	Engineering = 27 Science/health science = 19 Business = 14 Social science = 11 Business/science = 1 Art = 5 Education = 4
University locations (# of responses)	Northeast (64) Midwest (13) Southeast (2) West (1) Gap year (1)

3.1.3 Results

Two important findings resulted from this study. First, the group who reported struggling stress, depression, and anxiety (SDA) and the group who did not report suffering from SDA did not differ in the likelihood that they would use different types of technology in the practice of mindfulness. This result supports the likelihood that those in the SDA group would be willing to use technology for mindfulness since doing so would be more normalizing and not stigmatizing. As Table 2 reveals, we found no significant difference between the two groups (SDA and no SDA) in their willingness to use online guided breathing exercises, an app, Facebook group, online chat group, or Twitter for mindfulness-based activities.

Second, both groups had a strong preference (over 70%) for using a mindfulness app on a smartphone that contained guided meditations (see Table 3). In second and third place, they preferred guided breathing online or through a YouTube channel. Finally, they preferred Facebook and Twitter the least.

Table 2. Type of Technology Likely to Use

Type of tech pairing	Mean		t-test (p-value) Significance
	No SDA group	SDA group	
Online guided breathing exercises	2.09	2.28	-1.06 (.292), no difference
Mindfulness app on phone	2.83	2.96	-.56 (.579), no difference
Facebook group on mindfulness	2.91	2.65	1.09 (.280), no difference
Online chat room on mindfulness	2.66	2.87	-1.23 (.224), no difference
Use twitter	2.29	2.17	.45 (.652), no difference

Note: four-point Likert scale (the lower the number, the more likely the respondent would be to use it).

Table 3. Preferred Technology*

I would consider using...	No SDA group	No SDA group rank order	SDA group	SDA group rank order
Online guided breathing exercises	57.1%	3	50.0%	2
YouTube channel with online resources	60.0%	2	47.8%	3
Mindfulness app on phone with guided meditation	71.4%	1	71.7%	1
Mindfulness Facebook group	28.6%	4	15.2%	5
Twitter mindfulness campaign	17.1%	5	26.1%	4

* Values under the "group" columns indicate the percentage of participants in each group who would be willing to use that technology in the future. The values under the "rank order" columns indicate the rank of each technology in each group (1 is the most likely to be used in the future).

3.2 Study 2

After finding that college students with and without SDA ranked a mindfulness app with guided meditation their number one preference, we conducted a second study that focused on *how* college students with mental health issues (SDA) would prefer to use a mindfulness app in their MBSR training.

3.2.1 Participants

We recruited participants who had self-identified as having anxiety, depression, or stress and had taken part in mindfulness-based training sessions on their campus from two colleges in the Northeastern United States. In all, we recruited nine college students (4 who identified as female, three as male, and two as other) over the age of 18. This number of participants concurs with Sauro and Lewis's (2016) conservative approach to user experience testing: one needs at least nine users to uncover moderately frequently occurring issues ($p = 0.25$, 92%) during product testing. In addition to previous mindfulness training, we screened participants to ensure that anxiety, depression, or stress had interfered with their doing things at least sometimes on a five-point Likert scale (1 = never; 5 = always). Eight respondents reported that depression sometimes to always got in their way, while all nine responded that both anxiety and stress sometimes to always did.

3.2.2 Materials and Procedure

Each participant filled out an online consent form prior to their interviews. The informed consent form (IRB approved) stated that: "The goal of this research is to obtain feedback on how college age students with mental health issues feel about MBSR and how an MBSR support app would be accepted and used". After consenting, participants answered an online question related to how often stress, depression, or anxiety impacted their doing things. We invited participants that consented and answered in the positive for the online question to complete an in-person interview ($N = 9$). One researcher conducted individual interviews at a location convenient for each student (e.g., in an on-campus conference room).

At the start of each session, we asked the participants if we could audio record the interview to ensure we took accurate notes and reaffirmed that we would not report any personal identifying information. All participants agreed to have their session recorded. We began each session with the open-ended question "What is mindfulness to you?". Next, following a storyboard methodology, we showed participants a mock-up of a MBSR app (to help them envision one) (see Figure 1) and discussed features that may be helpful in a MBSR support app, such as general information (what mindfulness is), mindfulness exercises, a chat room (place to connect with others using the mindfulness app), a meditation timer, inspirational feedback (to help motivate and engage the user), and a place for listing local mindfulness events (Truong, Hayes, & Abowd, 2006). We then asked the participants a standard series of open-ended questions related to the app: "Would you use such an app in your MBSR practice?", "How would you use it?", "What features would be most useful to you?", "Do you think it would help reduce barriers to your practice of MBSR?", and "If the app was incorporated into MBSR training, which of the following formats do you feel it would best fit with?". We then gave participants given three options that we developed through discussions with MBSR experts

and deemed as viable approaches: 1) use the app between face-to-face classes, 2) more intensively use the app during courses, or 3) MSBR training provided completely via the smartphone app (see Table 4 for greater detail). We used descriptive statistics to analyze participants' answers to the closed-ended questions. We analyzed their answers to the open-ended questions using NVivo, a qualitative data-analysis package. Two researchers independently determined the nodes and coded the comments into them. They obtained an initial inter-rater reliability of 93.75 percent (as calculated by NVivo). The raters then met to resolve any issues in the nodes. This resulted in 100 percent agreement on nine overarching nodes: notable features, app appearance, mindfulness meaning, feature suggestions, mindfulness format, appearance suggestions, uses for app, least favorite features, and app name. The node "notable features" had the largest number of comments by far: it constituted 47 percent of participants' comments. Participants mentioned features such as push notifications and social features, which include a chat room and local events section, the most. Given that we did not garner any new information as we conducted more interviews, we considered that we achieved saturation at nine interviews (Mason, 2010).

Table 4. App Use Preferences

App use options*	Preference # (percentage)
1) Eight weekly two-hour classes and one all-day class on a Saturday or Sunday with presentations, teaching and practice of mindfulness and yoga practices, and discussion. App to be used in between classes on your own.	6 (66.67%)
2) The first and last classes are four hours on a Saturday morning separated by six weekly 90-minute live, interactive video classes via the app and one all-day class with presentations, teaching and practice of mindfulness and yoga practices, and discussion.	2 (22.22%)
3) The smartphone app completely teaches mindfulness and yoga practices and the "class" is a weekly one-hour live, interactive video class to discuss the material and practices with the teacher and other participants.	1 (11.11%)
* We selected these options based on the number one selected preferred technology, which we identified in the first study. Additionally, we consulted MBSR experts to ensure the options were reasonable.	



Figure 1. MBSR App Mock-up

3.3 Results

For the question “Would you use such an app in your MBSR practice?”, all participants described that they would be willing to try the app. For example, one participant said: “Yeah, especially with the mindfulness exercises, yoga, breathing, inspirational, calendar, timer to practice”. Even those who had used other mindfulness apps stated that they would use it:

I would try it out at the very least, because I do have an app right now that I use for mindfulness that I really like, that has led or guided meditation. But this seems like it has a wider variety of things. So, I'd definitely try it, yeah.

Looking specifically at the impact the app could have on their MBSR practice, four participants described that it would help them better incorporate MBSR into their lives. Most (N = 6) expressed a belief that having such an app would reduce the barriers to practicing MBSR. One participant said: “I think this would help with convenience and the calendar and timer would help with scheduling it in and making it more of a priority”.

Finally, we asked the interviewees which of the following formats we show in Table 4 they felt the app would best fit with if one incorporated the app into MBSR training. Of the three options given, a majority (N = 6) felt that a MBSR app would work most appropriately as a supportive tool in a face-to-face format. Only one felt that a smartphone app that exclusively provided mindfulness teaching by itself would present the most appropriate format.

4 Discussion

Several important findings emerge from this study. First, the results from both studies support using technology, specifically an app, to enhance college students' acceptability of and adherence to MBSR training. This finding concurs with previous findings that suggest online mindfulness-based interventions can effectively improve one's mental health (Spijkerman, Pots, & Bohlmeijer, 2016).

Second, both students with and without self-reported mental health conditions endorsed the belief that they would benefit from an app, which suggests that both groups would use it. This finding is important since students with SDA may be reluctant to use an app if they feel others (without SDA) would not use it and view those who did as unusual or defective. Given the stigma of mental illness, interventions that reduce the potential for stigmatization or discrimination are desirable.

Third, our focus on college students extends the findings of previous online mindfulness research that has examined participants with SDA (Pots et al., 2016; Bohlmeijer, Prenger, Taal, and Cuijpers, 2010; Trompetter, Bohlmeijer, Veehof, and Schreurs, 2014; Boettcher et al., 2014), but not necessarily young adults. More specifically, we introduced the MBSR intervention into a student environment and compared the potential app usage between students with and without SDA. This approach differs from what one can find in previous work, which has focused on websites that use the acceptance and commitment therapy (ACT) (Pots et al., 2016) and general mindfulness (Boettcher et al., 2014) methods.

Perhaps most significantly, we found that college students with SDA preferred to use an app *in conjunction* with an eight-week MBSR course. Students with SDA risk isolating themselves, which can lead to worsening symptoms and academic performance. Using an app in conjunction with the in-person course could help students with SDA form relationships with the instructor and other students in the MBSR training and, thus, prevent the app from increasing a student's isolation—a problem that people with SDA, who tend to withdraw from social activities, often face. Their preference for using an app in this way should help them accept it—an important consideration since previous studies have not compared in-class versus online offerings of MBSR training specifically.

The responses from participants in the second study who had experience with mindfulness training and had SDA indicated that an app would best work as a supportive tool to help with reminders, practice, and connecting to others. Instructors could also ensure that the app provides quality resources by selecting practice videos and other resource material and placing them on the app to support students between classes.

Additionally, the results suggest that using an app in conjunction with live classes may address the previous finding that Internet-delivered mindfulness interventions in adults and college students have low adherence rates (Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012). Though one meta-analysis suggests pure online mindfulness-based interventions may reduce stress and that individuals may maintain the effects for up to one year (Spijkerman, Pots, & Bohlmeijer, 2016), its authors caution that the small number and significant variance across studies makes interpreting and generalizing the results difficult. Further, Mak, Choi, Chan, Lui, and Wu (2017) point out that “the high attrition rate in [their] study suggests the need for refinement in future technology-based psychological programs. Mental health professionals need to team up with experts in information technology to increase personalization of Web-based interventions to enhance adherence” (p. 1).

4.1 Limitations and Future Work

While this research provides useful insight into young adults' MBSR technology preferences, researchers need to actually develop and test a MBSR app in actual trial settings to create a fully functional MBSR app. On this note, we plan to build a functioning MBSR prototype app and test it in the three app use conditions: 1) app used only between classes, 2) most of the training via the app, and 3) all training via the app. Future work also needs to consider including MBSR trainers' preferences for video and training material in mindfulness apps.

Another limitation concerns our sample. For example, we drew participants from two colleges in the Northeastern United States. Though we drew participants from two different types of institutions (one a technical-focused university and the other a community college), future research needs to develop and test mindfulness apps with a larger population of students from a broader diverse group of universities. Doing so will expand the study's generalizability and ensure that a greater number of young adults adopt the apps.

Finally, since we recruited all subjects in the second study from face-to-face mindfulness classes, a bias against other formats may exist. As such, researchers could conduct a follow-up study that includes participants who have participated in other forms of mindfulness-based offerings (i.e., hybrid and online) to test this limitation. We plan to do so in a future study as well.

5 Conclusion

While many companies and technologists tout the benefits of pure online or digital solutions to mindfulness practice, college students who struggled with SDA clearly signaled that they did not prefer a technology solution alone and that they found such a solution insufficient. They indicated that they would rather use the technology to support rather than replace in-person classes. Specifically, among technology options, an app provides an easy, accessible tool for those who struggle to practice mindfulness in person or otherwise regardless of SDA.

Further, we highlight the fact that college age students with and without SDA would use a MBSR app—a significant finding since the MBSR's use should normalize the app and not stigmatize those with SDA. Such broader acceptance of an app will likely lead more individuals with SDA to use it and, thus, to more support for their MBSR practice.

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