Effects of Text Message Reminders of Safety Behavior Reduction on Health Anxiety: A Randomized Controlled Trial

Kavi Jakes

Dr. Bunmi Olatunji

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Abstract

Health anxiety is a chronic disorder associated with poor functioning that is especially important to study in the context of the COVID-19 pandemic. Cognitive-behavioral models of health anxiety posit that safety behaviors are a key maintenance factor in health anxiety. The present study evaluated the effects of a safety behavior reduction text message reminder on symptoms of health anxiety. A sample of health-anxious participants (N = 99) were randomized to either a safety behavior reduction (SB) or mindfulness-based present-centered (PC) condition. Participants received text messages every other day for four weeks reminding them either to stop using their most common safety behaviors (SB) or to remain focused on the present (PC). Measures of safety behavior use, mindfulness, and health anxiety symptoms were completed at baseline, mid-treatment, post-treatment, and a four-week follow-up. It was hypothesized that participants in both conditions would report significant reductions in health anxiety symptoms over time, and that participants in the SB condition would report significantly greater reductions in health anxiety symptoms over time relative to the PC condition. Results indicated that participants in both conditions experienced significant reductions in health anxiety symptoms over time, with no significant difference in reductions between the two conditions. These findings suggest that both increasing mindfulness and reducing safety behavior use are relevant mechanisms through which health anxiety can be reduced. Implications for further development of scalable interventions for anxiety-related disorders are discussed.

Effects of Text Message Reminders of Safety Behavior Reduction on Health Anxiety: A Randomized Controlled Trial

Health anxiety is a chronic disorder associated with poor mental and physical health functioning (Fink et al., 2010) and is characterized by an excessive preoccupation of acquiring or having a serious illness (Asmundson & Fergus, 2019). Estimates for the 12-month prevalence rate range from 2.1%-13.1% (Bendau et al., 2023; Scarella et al., 2019), and clinical diagnoses and poor functioning persist for years (Barsky et al., 1998; Fink et al., 2010). Health anxiety places significant unnecessary burden on the healthcare system, as people with health anxiety utilize healthcare at a rate that is 41-78% greater than individuals with true illness symptoms (Fink et al., 2010). Individuals with elevated health anxiety also pay greater total outpatient costs and see more specialists than the general population (Scarella et al., 2019), in the absence of an objective need to do so.

In addition to high healthcare costs and impaired functioning, health-anxious individuals have been especially negatively impacted by the recent COVID-19 pandemic. Indeed, greater health anxiety was significantly associated with increased COVID-19 fears (Yalçın et al., 2022) and anxiety (Jungmann & Witthöft, 2020), and was found to predict perceived COVID-19 danger, beyond the effects of other relevant variables such as age, gender, negative affect, stress, and contamination symptoms (Sica et al., 2021). Even as the COVID-19 pandemic subsides, its impacts on health anxiety may persist in future years. Individuals may continue to practice learned increased awareness of potential COVID-19 symptoms, displaying a maintained attention to health-relevant stimuli that is characteristic of health anxiety (Shi et al., 2022). The negative effects of the COVID-19 pandemic have highlighted the need to better understand and target mechanisms implicated in the maintenance and treatment of health anxiety.

Excessive health anxiety can be understood through a cognitive-behavioral model, much like other anxiety-related disorders (Olatunji et al., 2009; Rachman, 2012). Health-anxious individuals overestimate the likelihood of getting severely sick (Rachman, 2012) and misinterpret ambiguous cues (e.g., bodily signs, symptoms, medical information) as dangerous and catastrophic (Du et al., 2023; Rachman, 2012; Salkovskis & Warwick, 2001). Such misinterpretations lead health-anxious individuals to use safety behaviors as a means of reducing anxiety related to their feared outcome (e.g., contracting an illness). Safety behaviors are unnecessary actions taken to prevent, escape from, or reduce the severity of a perceived threat (Telch & Zaizar, 2020), and are common across anxiety disorders (Shear et al., 2007). Individuals with high health anxiety use more safety behaviors — which include bodily checking, repeated and excessive medical consultations, and avoidance of individuals perceived to be ill — than individuals with low health anxiety (Tang et al., 2007).

Safety behaviors have also been shown to maintain anxiety (Wells et al., 1995) by promoting a misattribution of safety (Salkovskis, 1991), whereby a person incorrectly believes a non-occurrence of their feared outcome results from the use of a safety behavior. This misattribution of safety prevents disconfirmatory experiences, during which an individual would be able to see that their feared outcome does not naturally occur (Clark & Wells, 1995). These disconfirmatory experiences are imperative for corrective learning (e.g., “contracting a severe illness was not as likely as I expected”) that reduces subsequent misinterpretations of ambiguous stimuli. In fact, Engelhard and colleagues (2015) found that use of safety behaviors directed toward a non-threatening stimulus increased subsequent threat perceptions of that stimulus. Safety behavior use not only inhibits the learning required to confront misinterpretations of ambiguous stimuli; it also contributes to such misinterpretations.

The extant literature provides empirical support for safety behaviors causing increased health anxiety symptoms. In a study by Olatunji and colleagues (2011), participants who were instructed to engage in health-relevant safety behaviors as much as possible for one week reported significantly greater behavioral avoidance, levels of health anxiety, and hypochondriacal beliefs compared to a control condition. Similarly, undergraduate students who spent a week engaging in contamination-related safety behaviors on a daily basis reported significant increases in contamination fears, threat overestimation, and behavioral avoidance independent of their baseline contamination fear (Deacon & Maack, 2008). These experiments highlight the critical role of safety behaviors in the development of health anxiety, whereby increasing safety behavior use increases anxiety symptoms and avoidance.

There is competing evidence regarding whether safety behaviors are important to address within exposure-based treatments for anxiety disorders. Exposure and response prevention (ERP) is considered to be the gold-standard cognitive-behavioral treatment for anxiety disorders (Katzman et al., 2014), and involves the systematic confrontation of feared stimuli in the absence of safety behaviors. ERP intentionally prevents safety behavior use in order for individuals to learn disconfirmatory information that is incompatible with their beliefs — that even in the absence of safety behaviors, their feared outcome does not occur or is not as catastrophic as they expect it to be. A literature review of exposure-based studies supported this approach, arguing that safety behaviors have a detrimental effect on treatment success and should be targeted and eliminated during exposure therapy (Helbig-Lang & Petermann, 2010).

However, some researchers have looked toward utilizing the initial anxiety reduction component of safety behaviors within exposure therapy. Since exposure requires the patient to encounter stressful stimuli, there is an argument for the “judicious use of safety behaviors” as a

means of reducing patients' initial anxiety and making treatment more tolerable (Rachman et al., 2008). In support of this theory, a randomized controlled trial in a sample of spider-phobic participants compared exposure without safety behaviors to exposure with the proposed "judicious use of safety behaviors" and found no significant effect of condition on spider fears, treatment tolerability, or peak distress during a behavioral task (Blakey et al., 2019). This result suggests that safety behaviors do not necessarily need to be eliminated in order for exposure treatment to be successful. Similarly, a meta-analysis of the use of safety behaviors in exposure reported that it was inconclusive as to whether exposure treatment outcomes are better with or without safety behaviors (Meulders et al., 2016). This ongoing debate regarding the optimal approach to safety behaviors in exposure treatments highlights a continued need to understand the mechanistic role of safety behaviors in anxiety disorders and if safety behaviors are relevant targets for treatment.

While a large body of research exists on safety behaviors in the context of exposure treatments, few studies have examined safety behavior reduction in isolation as a specific intervention for anxiety-related disorders. Recent randomized controlled trials have targeted safety behaviors in isolation by sending text messages to participants reminding them not to use their most common safety behaviors. This text message reminder approach led to significant reductions in relevant symptoms for samples of individuals with elevated social anxiety, appearance concerns, and bulimic symptoms (Cougle et al., 2020; Stentz et al., 2022; Wilver et al., 2020). The digital, efficient nature of the text message reminder intervention is particularly encouraging. Participants completed these studies remotely with minimal interaction with researchers. Additionally, researchers created and sent the text message reminders in an automated manner, suggesting low researcher burden. Participants' symptoms declining in these

studies highlights how safety behavior reduction in isolation may be an effective intervention that can be applied via a remote, simple method.

While the safety behavior reduction text message reminder approach has shown promise for other anxiety-related disorders (Cougle et al., 2020; Stentz et al., 2022; Wilver et al., 2020), no studies to date have attempted to extend it to health anxiety. Thus, the primary goal of the study was to evaluate the effect of the safety behavior reduction text message reminders on health anxiety symptoms. A secondary goal was to examine how safety behavior use might explain changes in health anxiety symptoms. Participants were randomized to one of two 4-week text message reminder conditions. Participants in the safety behavior (SB) condition received texts reminding them to stop using their most frequent safety behaviors, while those in a mindfulness-based present-centered control (PC) condition received texts reminding them to stay focused on the present. It was hypothesized that participants in both conditions would report significant reductions in health anxiety over time (Hypothesis 1). Additionally, it was hypothesized that participants in the SB condition would report significantly greater reductions in health anxiety symptoms (Hypothesis 2) and safety behavior use (Hypothesis 3) over time compared to the PC condition. Given that mindfulness was implicated in the PC condition, mindfulness was included as an outcome measure. However, no predictions were made regarding the effect of condition on mindfulness.

Method

Participants

Participants were recruited via university-sponsored mass email distributions and ResearchMatch, a national health volunteer registry that was created by several academic institutions and supported by the U.S. National Institutes of Health as part of the Clinical

Translational Science Award (CTSA) program. ResearchMatch has a large population of volunteers who have consented to be contacted by researchers about health studies for which they may be eligible. Review and approval for this study and all procedures was obtained from the university's institutional review board. Participants were considered eligible if they a) were 18 years of age or older, b) had access to a cellphone that could send and receive text messages, c) had access to a device that could access the Internet, and (d) scored 27 or greater on the Short Health Anxiety Inventory, a cut-off that best balanced sensitivity and specificity when differentiating between health anxiety and other anxiety disorders (Abramowitz et al., 2007; Alberts et al., 2013), and thus maximized the relevance and benefit of the study for participants. Individuals were excluded if they were immunocompromised, lived with someone who was immunocompromised, had a history of psychotic symptoms, had changes in psychiatric medication within the last month, were currently receiving therapy for health anxiety, or responded with a score less than 5 when asked, "On a scale of 1 (no motivation) to 10 (extremely motivated), how motivated are you to complete this treatment in full?" The final sample consisted of 99 participants who completed the study and were included in data analyses (see Figure 1 for CONSORT diagram).

Measures

Short Health Anxiety Inventory (SHAI; Salkovskis et al., 2002) is an 18-item self-report measure that assesses symptoms of health anxiety, such as thoughts surrounding getting sick, worries about health, and perception of bodily sensations. For each item, individuals are asked to select which of four statements best applies to them. The SHAI has demonstrated good internal consistency (αs .= 84-.89) and adequate test-retest reliability (α = .87) in a study involving

recording safety behaviors (Olatunji et al., 2011). Internal consistency was good at baseline in the present study (α = .81).

Whiteley Index (WI; Pilowsky, 1967) is a 13-item self-report that measures health anxiety symptoms, focusing on illness fears and perception of internal sensations. Individuals are asked to give a "Yes" or "No" response to each item. Internal consistency was questionable to adequate in the present study (αs = .61-.78).

Safety Behavior Checklist (SBC; Olatunji et al., 2011) is a 34-item self-report measure of an array of health-related behaviors, including carrying anti-bacterial hand sanitizer, taking an aspirin tablet, or asking for medical advice. The checklist was modified to a frequency Likert scale ranging from Never (0) to Always (4) for this study, rather than a daily checklist of the behaviors, to resemble the Subtle Avoidance Frequency Examination (Cuming et al., 2009) used to assess safety behavior use in a prior study of safety behavior reduction via text message reminders (Cougle et al., 2020). Internal consistency was excellent in the present study (αs = .90-.93).

Cognitive and Affective Mindfulness Scale Revised (CAMS-R; Feldman et al., 2007) is a 12-item self-report measure designed to capture a broad conceptualization of mindfulness, including concentration ability, remaining grounded in the present, and awareness of thoughts and feelings. The CAMS-R has demonstrated adequate convergent and divergent validity and adequate internal consistency (α = .74; Feldman et al., 2007). Internal consistency was questionable to acceptable in the present study (αs = .64-.71).

Design

Participants were randomly assigned to either the Safety Behavior (SB) or Present Centered (PC) text message reminder condition and completed study measures at four time

points: baseline (pre-treatment), 2 weeks (mid-treatment), 4 weeks (post-treatment), and 8 weeks (follow-up).

Interventions

Safety Behavior Condition

Participants in the Safety Behavior (SB) condition received the following rationale that explained the detrimental effects of safety behavior use in maintaining health anxiety:

> Safety behaviors are behaviors we use to make us feel less anxious and prevent bad things from happening. For example, some people may avoid touching public door handles/railings, carry hand sanitizer throughout their day, monitor their bodies for signs of illness, or frequently seek reassurance from doctors, internet sources, or family members that they aren't sick. Safety behaviors can be problematic because when we use them, we are never able to see that the outcome we fear doesn't come true. We might say to ourselves, "The reason I did not get sick is because I adequately sanitized, got reassurance from the internet, doctors, or other people, …" or used other safety behaviors. Safety behaviors can become something we heavily rely on to feel less anxious. Research has found that dropping safety behaviors can help reduce anxiety. We would like for you to focus on the three safety behaviors you chose before. We are asking you to please avoid using these behaviors for the duration of the study. We know it will be difficult to do, but we anticipate that as you drop these behaviors, you will learn that your fears do not come true. Because this may be difficult to remember, we will also send text messages every few days to remind you to drop these behaviors.

Participants then received texts reminding them to avoid using the three safety behaviors that they reported using most often on the Safety Behavior Checklist at baseline. The safety behaviors listed in the texts were updated midway through the intervention to match the three most commonly used safety behaviors that participants reported at the mid-treatment survey.

Present Centered Condition

Participants in the Present Centered (PC) condition received the following rationale that described the potential benefits of focusing on the present to reduce anxiety and improve overall mood:

> It is easy to get lost in our worries and think about what happened in the past or is about to happen in the future. Research has found that being focused on the present can help reduce anxiety and improve your overall mood. Many things draw our attention away from the present. Someone with health anxiety can worry about a sensation they felt earlier and may go over and over in their minds what it means for their health. They might also become very anxious about a situation they are about to enter. These worries and anxieties occur because we are focusing on everything but the present. By training yourself to attend to the present moment, you can help reduce worry about having or acquiring illness. We are asking you to please attempt to focus on the present for the duration of the study. Focus on your breathing, on details about your current experience, and where you are. Be mindful of your surroundings. We know it will be difficult to do, but we anticipate that as you focus on your present experience, you will feel less anxiety regarding your health. Because this may be difficult to remember, we will send text messages every few days to remind you to focus on the present.

The PC condition received the same number of text messages as the SB condition, but all texts reminded them to remain focused on the present. A rotating set of three texts were sent to these participants such that they received the same text message every three texts.

Procedure

All aspects of the study were approved by the University's Institutional Review Board. Consent forms were collected and managed using REDCap (Harris et al., 2009, 2019), a secure, web-based software platform designed to support data capture for research studies. After completing informed consent, prospective participants were automatically directed to a Qualtrics survey where they answered exclusion criteria questions and completed the SHAI to confirm

eligibility. Ineligible participants were displayed a message informing them of their ineligibility for the study. Eligible participants continued within the baseline Qualtrics survey to complete demographic information and self-report measures. After completing the self-report questionnaires, participants were automatically randomized to either the Safety Behavior (SB) or Present Centered (PC) condition via block randomization within Qualtrics. Participants were displayed a four-digit code and were asked to text that code to the study's Google Voice phone number to confirm the participant's phone number. Participants were then provided with a statement for their assigned condition that explained the rationale for the condition and the text message reminder process. Participants who correctly confirmed their phone number and completed the baseline Qualtrics survey were enrolled in the study.

After completing the baseline survey, participants received a reminder text message every other day for 13 days (7 reminder texts) from the study's phone number. Using Boomerang and Google Voice, text messages were scheduled to be sent at 12:00 p.m. in the participant's time zone. The day after receiving their 7th text, participants received both an email and a text message with the link to complete the mid-treatment survey, which consisted of study outcome measures. Reminder text messages were updated as necessary and started again the day after participants completed the mid-treatment survey. Participants again received a text message reminder every other day for 13 days from the study's phone number. The day after receiving their last reminder text, participants received both an email and a text with the link to complete the post-treatment survey, which was identical to the mid-treatment survey. Following completion of the post-treatment survey, participants did not receive any reminder text messages or communications for four weeks. After four weeks, participants received a final email and text to complete an identical follow-up survey. Participants were then debriefed.

Participants who completed the study in full earned $40, and a $10 bonus was granted for participants who completed all study measures within 48 hours of receiving them. Compensation was distributed in the form of an Amazon e-gift card. Additionally, all participants who completed the study in full were entered into a raffle for a $100 Amazon e-gift card.

Data Analysis

Chi-square tests and independent groups *t*-tests were conducted to examine potential baseline differences in demographic and outcome variables between the two conditions. For our primary analyses, we conducted repeated-measures analyses of variance (ANOVA) to assess differences between the two conditions in symptom changes across time. A separate ANOVA was conducted for each of the three outcome variables: safety behavior use, mindfulness, and health anxiety symptoms. For each ANOVA, time was set as the within-subjects factor and condition as the between-subjects factor. In the event that Mauchly's test of sphericity was violated, Greenhouse-Geisser corrections were applied.

Results

Baseline Comparisons

Baseline group differences were examined for demographic and outcome variables. Results for demographic variables are displayed in Table 1. There were no significant differences between the two conditions in demographic characteristics (all *p*s > .08) or outcome variables at baseline (all *p*s > .38).

Effects of Condition

For each condition, descriptive statistics for measures of safety behaviors, mindfulness, and health anxiety over time are presented in Table 2.

Safety Behaviors

A 2 (Condition: SB, PC) × 4 (Time: pre-, mid-, post-intervention, follow-up) repeated-measures ANOVA revealed a significant main effect of time, $F(2.39) = 6.14$, $p = .001$, such that participants' safety behavior use decreased from baseline to the four-week follow-up. The time × condition interaction was marginally significant, $F(2.39) = 2.61$, $p = .066$ (see Figure 2).

Mindfulness

A 2 (Condition: SB, PC) × 4 (Time: pre-, mid-, post-intervention, follow-up) repeated-measures ANOVA revealed a significant main effect of time, $F(2.89) = 16.20$, $p < .001$, such that participants' mindfulness increased from baseline to the four-week follow-up. The time × condition interaction was not significant, $F(2.89) = 1.38$, $p = .249$ (see Figure 3).

Health Anxiety

A 2 (Condition: SB, PC) × 4 (Time: pre-, mid-, post-intervention, follow-up) repeated-measures ANOVA revealed a significant main effect of time, $F(2.48) = 9.86$, $p < .001$, such that participants' health anxiety symptoms decreased from baseline to the four-week follow-up. The time × condition interaction was not significant, $F(2.48) = 1.92$, $p = .138$ (see Figure 4).

Exploratory Analysis

Within the SB condition, we also examined whether results differed among those with low versus high engagement in the study manipulation (i.e., less or greater safety behavior reduction, respectively). We calculated reductions in safety behavior use from pre- to post-treatment, and split SB participants into two equally sized groups: low engagement (less safety behavior reduction) and high engagement (greater safety behavior reduction).

A 3 (Group: SB low engagement, SB high engagement, PC) × 4 (Time: pre-, mid-, post-intervention, follow-up) repeated-measures ANOVA on WI scores displayed a significant time × group interaction, $F(5.09) = 2.83$, $p = .016$. Further examination of this interaction using a

separate repeated-measures ANOVA for each group showed significant reductions in health anxiety symptoms from baseline to the four-week follow-up for the high engagement safety behavior, $F(2.08) = 3.64$, $p = .033$, and present-centered groups, $F(2.60) = 11.68$, $p < .001$, but not the low engagement safety behavior group, $F(3) = .61$, $p = .610$. Changes in health anxiety symptoms over time for each group are depicted in Figure 5.

Discussion

The present study investigated the effectiveness of text message reminder interventions for reducing health anxiety symptoms and safety behavior use. Consistent with Hypothesis 1, results from this randomized controlled trial indicated that participants in both conditions reported significant reductions in health anxiety from baseline to the four-week follow-up. These results suggest that text messages reminding participants to reduce safety behaviors and to remain focused on the present were both effective in reducing health anxiety symptoms over time. Present study findings are also consistent with prior research, which has shown that both safety behavior reduction and present-centered text interventions significantly reduce social anxiety symptoms (Cougle et al., 2020).

Health anxiety reduction in the SB condition is consistent with the broader literature and suggests that safety behavior reduction is a critical component to health anxiety treatment (Gropalis et al., 2018; Hedman-Lagerlöf & Axelsson, 2019) and that safety behavior reduction in isolation is effective in reducing anxiety-related symptoms (Cougle et al., 2020; Stentz et al., 2022; Wilver et al., 2020). Such results emphasize that safety behaviors are an important mechanism in the maintenance of anxiety-related disorders, and that solely targeting safety behaviors can be beneficial for reducing anxiety symptoms. It may be the case that as individuals reduce their safety behaviors, they have the chance to acquire disconfirmatory information that

disproves their existing beliefs about the likelihood or severity of contracting an illness (Abramowitz & Braddock, 2008; Hedman-Lagerlöf & Axelsson, 2019). Similarly, health anxiety symptom reduction in the mindfulness-based PC condition is consistent with research indicating that improving mindfulness is a path through which health anxiety symptoms can be decreased (Hedman et al., 2017; McManus et al., 2012). A majority of patients with diagnosed health anxiety experience future-oriented imagery regarding illness and death that often leads to rumination (Muse et al., 2010), which in turn maintains health anxiety symptoms (e.g., Marcus et al., 2008). Thus, one potential explanation is that the PC condition's emphasis on remaining focused on the present may have facilitated less engagement with future-oriented thoughts and as a consequence, decreased rumination. Given that health-anxious fears are often distant and can be difficult to disconfirm, another possibility is that the PC condition promoted a tolerance of uncertainty that allows participants to "sit with" their fears instead of trying to change them. Indeed, reductions in intolerance of uncertainty have been shown to mediate the effect of mindfulness improvements on health anxiety symptom reduction (Kraemer et al., 2016).

Contrary to hypotheses 2 and 3, the two conditions did not significantly differ in safety behavior use and health anxiety symptom reduction across time. The lack of a significant time by condition interaction for safety behavior use was unexpected, as text message reminders were specifically geared toward safety behavior reduction only in the SB condition. Although both groups experienced a reduction in safety behavior use over time, the brief SB intervention rationale may have been insufficient to capture significant group differences in the wake of COVID-19. It may be the case that participants in the SB condition were somewhat resistant to reducing safety behaviors as a result of the ongoing and salient health threat of the COVID-19 pandemic. Participants may have felt willing to decrease some behaviors (e.g., eating organic

foods) but viewed others (e.g., washing hands) as a necessity to stay safe. Indeed, it has been shown that stronger beliefs about the necessity of safety behavior use for purposes such as everyday functioning, tolerating distress, and reducing likelihood and severity of a feared outcome is correlated with greater safety behavior use (Meyer et al., 2019). Further, as the PC condition spent more time attending to the present moment (rather than future-oriented, potential threat), they may have experienced less of a need to engage in safety behaviors to prevent such threat. Additional research is needed to better understand which strategies most effectively facilitate the reduction of health anxiety and safety behavior use over time.

Additionally, results from the present study revealed that mindfulness increased from baseline to four-week follow-up for both conditions (see Figure 3), but there were not significant differences between the two conditions in mindfulness over time. While improvements in mindfulness in the PC condition can be attributed to the mindfulness-based rationale and text message reminders, mindfulness improvements in the SB condition were less expected. Previous research has shown that self-focused attention mediates the effect of safety behavior use on anxiety symptoms (Desnoyers et al., 2017), suggesting that safety behavior reduction may cause reduction in self-focused attention. Though self-focused attention was not captured in the present study's measure of mindfulness, a more general form of attention (e.g., It is easy for me to concentrate on what I am doing, I am able to pay close attention to one thing for a long period of time) was included. It may be the case that safety behavior reduction impacts attention more broadly, and that safety behavior reduction in the SB condition contributed to improvements in attention that were captured in the study's measure of mindfulness. Thus, the PC condition's improvements in mindfulness may have occurred directly through the condition's rationale and

text message reminders, while improvements in mindfulness in the SB condition occurred through an alternate pathway involving safety behavior reduction.

In our exploratory analysis, we considered the role of engagement in the effectiveness of the SB condition by dividing the SB condition into low and high engagement groups. Results revealed that PC and high engagement SB participants experienced significant reductions in health anxiety symptoms over time, while low engagement SB participants did not. The exploratory analysis yields additional support for the importance of eliminating safety behaviors in treatment for anxiety disorders. Participants in the SB condition that reduced their safety behaviors more had greater reductions in health anxiety, suggesting that health anxiety symptom reduction in the SB condition was tied to safety behavior reduction. Insufficient psychoeducation regarding the importance of eliminating safety behavior use and the context of COVID-19 may explain why some participants in the SB condition reduced their safety behavior use more than others. The SB low engagement and high engagement groups may also have differed in perceived treatment credibility, which is a predictor of successful outcome for cognitive-behavioral treatments for health anxiety (Hedman et al., 2015). The low engagement SB group may not have regarded the rationale of the SB condition as an intervention that would improve their health anxiety, and thus did not adequately engage with the safety behavior elimination encouraged by the text message reminders. Given the differences in health anxiety symptom reduction displayed between the low and high engagement SB groups, interventions focused on safety behavior reduction such as the one employed in this study should consider methods of improving engagement with safety behavior reduction. Providing psychoeducation that strongly conveys the importance of eliminating safety behavior use and enhancing treatment credibility are potential pathways to foster successful engagement and treatment outcome.

While strategies for optimizing safety behavior reduction treatments should certainly be explored in future research, the effectiveness of the intervention in the present study highlights the viability of remote and scalable treatments. Participants only communicated with the principal investigator via email and text messages, and the combination of brief psychoeducation and text message reminders were effective in reducing health anxiety symptoms. This demonstrates how an intervention can have its intended effect in the absence of face-to-face discussion, which supports the use of remote, technology-based interventions. Additionally, the research group was tasked only with scheduling emails and text messages via Google Voice. Such limited researcher burden in the current study presents promise for scalable treatments that can reach more people and thus address the issue of treatment shortages among people with anxiety disorders (Alonso et al., 2018). Moreover, the results of the present study as well as similar prior research (Cougle et al., 2020; Stentz et al., 2022; Wilver et al., 2020) indicate that reducing safety behaviors is a relevant target for simple, remote interventions for anxiety-related disorders.

There are limitations in the present study that should be considered. While there were exclusion criteria for being immunocompromised or living with someone who is immunocompromised, we did not differentiate between participants with or without an additional health condition in our analyses. It may be the case that health anxiety symptomology is different when patients have clear, legitimate symptoms of physical illness. Indeed, this is the basis of the distinction between somatic symptom disorder (symptoms present) and illness anxiety disorder (symptoms absent) in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013). Additionally, we did not assess for comorbid mental disorders, which may have influenced participants' responses to the interventions. Future studies should

address these limitations by examining potential differences in safety behavior use between illness anxiety disorder and somatic symptom disorder and the potential impact of comorbid mental diagnoses on the effectiveness of safety behavior reduction interventions for health anxiety.

Future studies implementing safety behavior reduction interventions for anxiety disorders should measure study outcomes more frequently and establish a no-treatment control condition to better assess the mechanisms involved in the interventions' effectiveness. Participants were asked to report their safety behavior use only at four designated timepoints and may have had difficulty correctly recalling their safety behavior use over periods of multiple weeks. Implementing a daily safety behavior checklist (Olatunji et al., 2011) could better evaluate the true nature of safety behavior use over the course of the study, although this method would likely reveal the primary focus of the study to participants in the PC condition. Additionally, future studies may benefit from adding a no-treatment control condition. Reported reductions in health anxiety symptoms over time may be reflective of expectancy effects arising from completing study measures multiple times. Including a no-control condition would address these concerns and enable researchers to better assess the effects of the interventions.

In summary, the present study examined the effects of two text message reminder interventions on health anxiety symptoms in a health-anxious sample. Reductions in health anxiety symptoms in both the safety behavior reduction and present centered conditions point toward both decreasing safety behavior use and increasing mindfulness as viable targets for reducing health anxiety. Identifying paths through which to reduce health anxiety is important research to conduct in the context of the COVID-19 pandemic, which has been especially distressing for individuals with elevated health anxiety (Jungmann & Witthöft, 2020; Yalçın et

al., 2022). The current study is the first to extend the safety behavior reduction text message reminder intervention to health anxiety. The effectiveness of this simple method for reducing health anxiety symptoms is promising amidst a push for more scalable evidence-based interventions. Future research should continue the work of developing simple, scalable interventions for health anxiety and other anxiety disorders.

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Table 1

Baseline Demographic Characteristics by Condition

Characteristic	PC condition (n = 53)	SB condition (n = 46)	t/χ^2	p
Age in years: *M* (*SD*)	36.6 (11.8)	32.9 (9.1)	1.72	.088
Gender *n* (*%*)			1.14	.566
Male	16 (30.2%)	12 (26.1%)		
Female	36 (67.9%)	34 (73.9%)		
Nonbinary	1 (1.9%)	0 (0.0%)		
Race/Ethnicity *n* (*%*)			1.33	.857
White/Caucasian	33 (62.3%)	32 (69.6%)		
African American/Black	13 (24.5%)	7 (15.2%)		
Hispanic/Latino	3 (5.7%)	3 (6.5%)		
Asian/Pacific Islander	2 (3.8%)	2 (4.3%)		
Two or more races	2 (3.8%)	2 (4.3%)		
Level of education *n* (*%*)			2.83	.419
High school diploma	0 (0.0%)	2 (4.3%)		
Some college	7 (13.2%)	8 (17.4%)		
Bachelor's degree	21 (39.6%)	17 (37.0%)		
Postgraduate degree	25 (47.2%)	19 (41.3%)		

Note. PC = Present Centered; SB = Safety Behavior.

Table 2

Descriptive Statistics of Outcome Variables

	Pre-treatment		Mid-treatment		Post-treatment		Follow-up	
	PC	SB	PC	SB	PC	SB	PC	SB
Measures	*M* (*SD*)							
SBC	75.6 (20.6)	78.0 (21.3)	75.6 (18.9)	70.3 (20.1)	72.5 (19.5)	69.5 (23.7)	73.5 (19.7)	69.4 (22.9)
CAMSR	28.9 (6.8)	27.8 (5.2)	30.7 (5.6)	28.3 (5.1)	31.2 (6.6)	28.8 (4.6)	32.0 (6.2)	30.0 (5.1)
WI	9.4 (2.2)	9.0 (2.2)	9.1 (2.6)	8.8 (2.7)	8.3 (2.5)	8.8 (2.9)	7.6 (3.2)	8.2 (3.0)

Note. PC = Present Centered condition; SB = Safety Behavior condition; SBC = Safety Behavior Checklist, CAMSR = Cognitive and Affective Mindfulness Scale-Revised; WI = Whiteley Index

Figure 1

CONSORT Diagram: Participant Flow and Retention

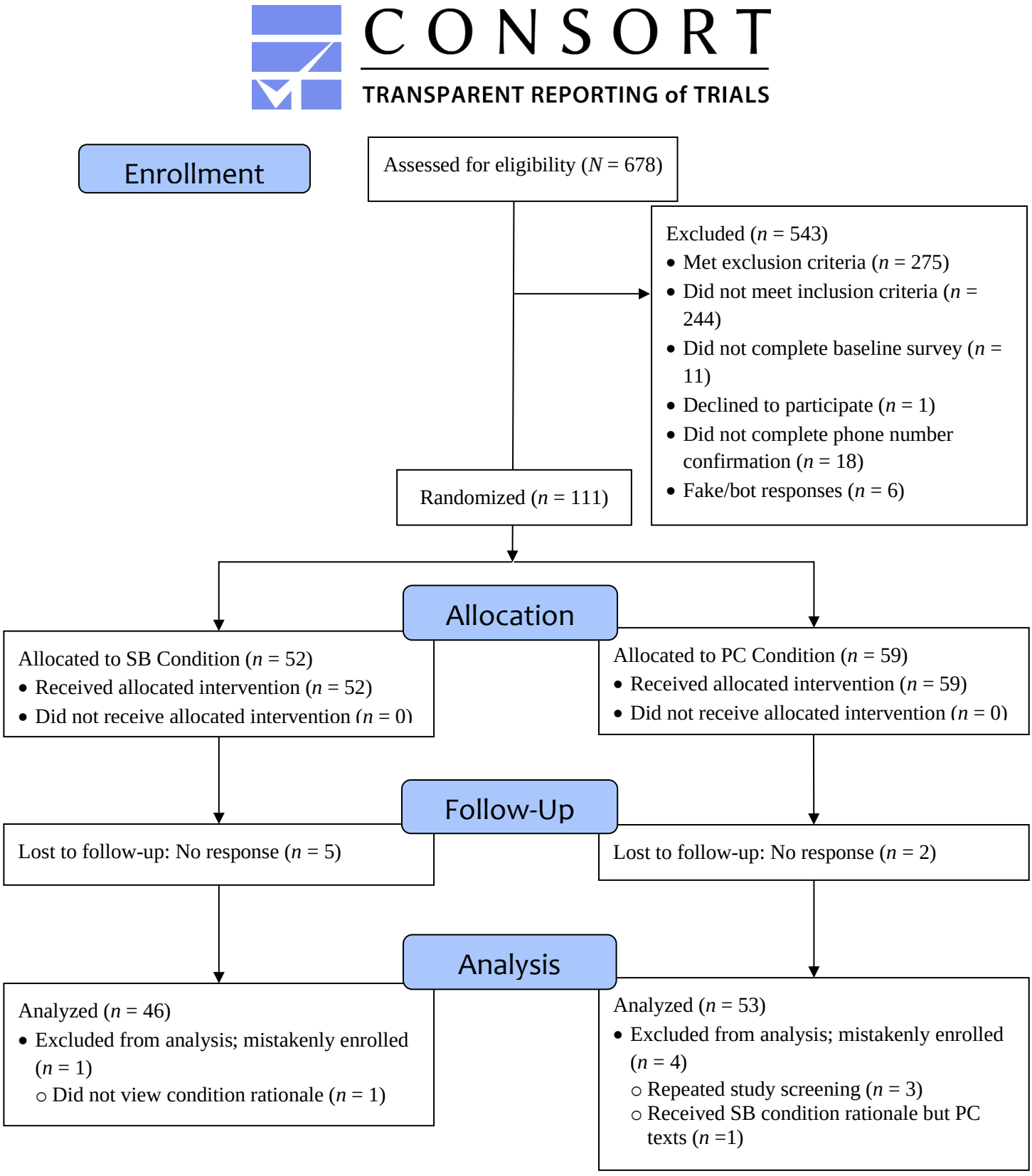
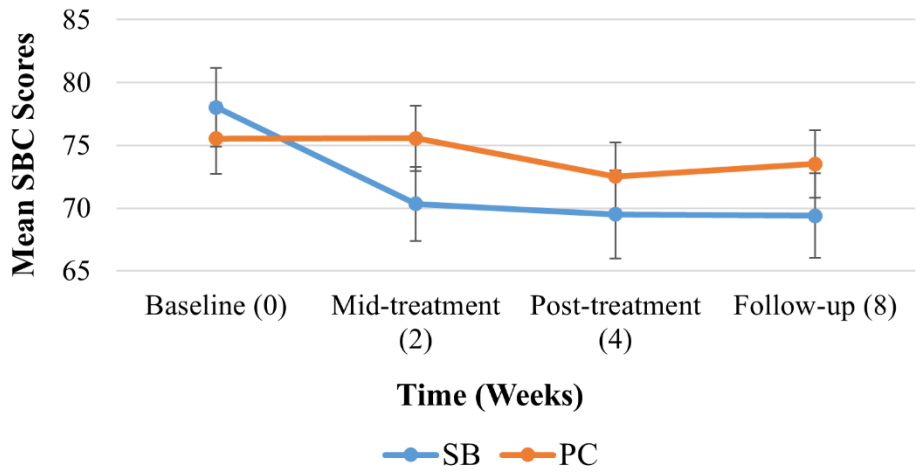


Figure 2

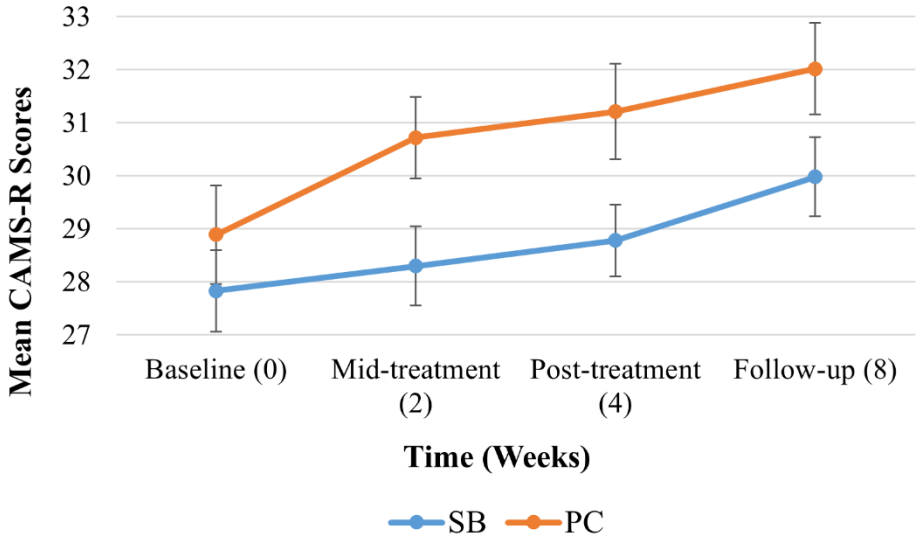
Changes in Safety Behavior Use



Note. Error bars ± 1 standard error; SB = Safety Behavior condition; PC = Present Centered condition.

Figure 3

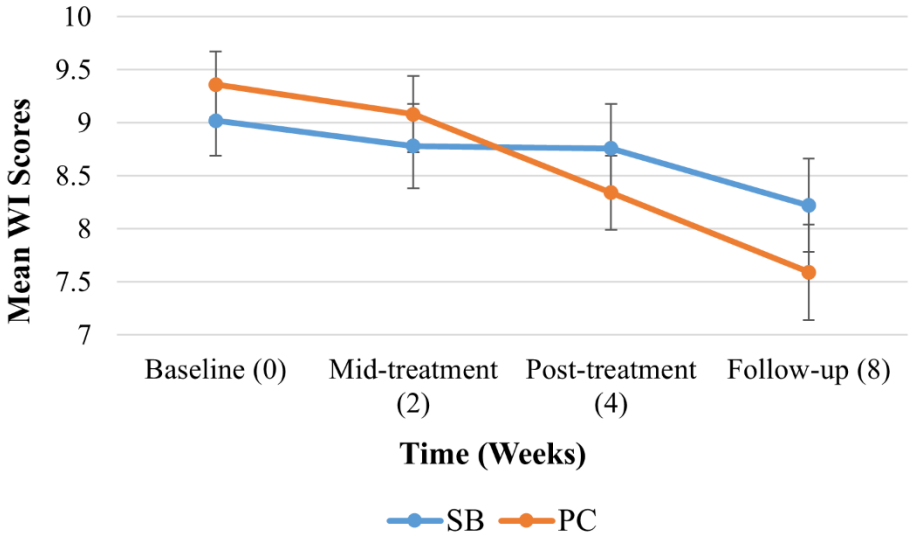
Changes in Mindfulness



Note. Error bars ± 1 standard error; SB = Safety Behavior condition; PC = Present Centered condition.

Figure 4

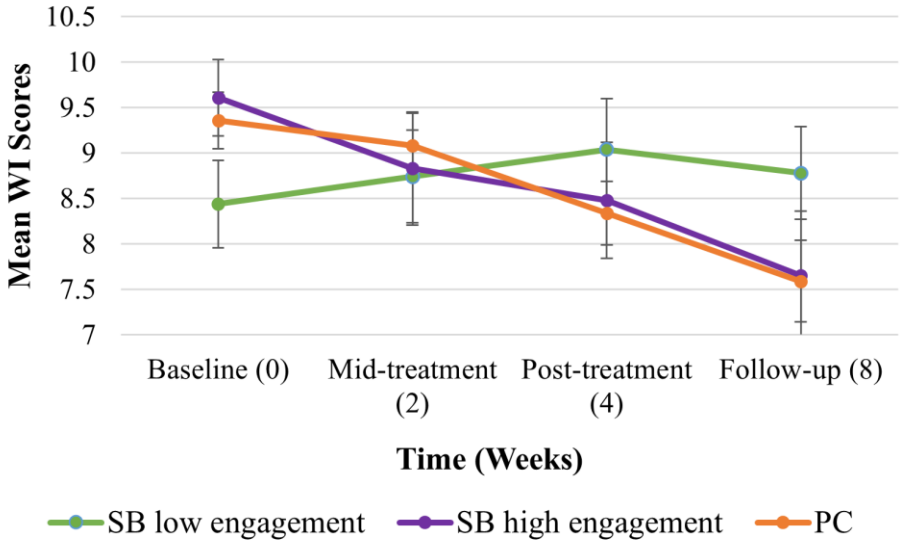
Changes in Health Anxiety Symptoms



Note. Error bars ± 1 standard error; SB = Safety Behavior condition; PC = Present Centered condition.

Figure 5

Health Anxiety Symptoms over Time by Group



Note. Error bars ± 1 standard error; SB = Safety Behavior condition; PC = Present Centered condition.