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# Anxiety Break: A Smartphone Application Used to Examine the Mediating Effects of Metacognition on Generalized Anxiety Disorder

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Anxiety Break: A Smartphone Application Used to Examine the Mediating Effects of  
Metacognition on Generalized Anxiety Disorder

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## Abstract

Worry is the highlight characteristic of generalized anxiety disorder (GAD). While worry is very common in anxiety disorders, it is important to note that worry is common in non-clinical populations as well. The current study focused on the metacognitive model of GAD (Wells, 2005). Various intervention types available for those with GAD have been examined. However, with the surge of technological advances being integrated into the field of psychology, it is important to examine technology-based treatments, more specifically smartphone application interventions. The purpose of the current study was to use a smartphone application (Anxiety Breaks; Habib, 2013) that targets worry in a population that met GAD criteria using the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990). The goal was to examine how metacognitions mediate GAD symptoms before and after a three-week trial of application usage. It was hypothesized that post-usage scores would reflect a reduction in anxiety symptoms. Twenty-six undergraduate students at a large Midwestern university who reached the proper criteria for GAD after a phone screening of the PSWQ were recruited. Students engaged in an hour-long time one survey and computer task after which they were given the smartphone application to use for three weeks if they were in the immediate group or were told to wait for three weeks if they were in the waitlist group. Both groups completed weekly PSWQ's and came in for another hour session after three weeks for time two and were given the opposite instructions from time one. At the end of the next three weeks, they were sent an online survey for time three. GADQ-IV and MCQ scores were predicted to decrease at time two after application use.

Repetitive, intrusive thoughts, heightened physiological responses, and avoiding behavior are characteristic symptoms of anxiety disorders (American Psychological Association, 2015). Subtypes of anxiety disorders include social anxiety disorder, separation anxiety disorder, specific phobias, panic disorder, post-traumatic stress disorder, obsessive-compulsive disorders, and generalized anxiety disorder (GAD). If these disorders go unattended, they only increase in severity, possibly contributing to lifelong debilitation (American Psychological Association, 2010). Many of these disorders are comorbid with other mental health issues, such as depression, substance abuse, and, in the child population, often ADHD (American Psychological Association, 2010). The current study's main focus is generalized anxiety disorder, which is characterized by intense and frequent worrying (Newman, Llera, Erickson, Prezeworski, & Castonguay, 2013).

David Barlow (2002) proposed the triple vulnerability model in regard to the developmental process of such anxiety disorders. He posited that the three vulnerabilities, generalized biological vulnerability, generalized psychological vulnerability, and specific psychological vulnerability, are all inclusive in the onset of anxiety disorders. The basis for the generalized biological vulnerability is that, while research has not identified one single gene that passes on anxiety disorders, there are certain proclivities that can be genetically inherited, such as the tendency to faint at the sight of blood. One may have a higher possibility of developing a disorder due to their genetic make up for reactions. Generalized psychological vulnerability focuses on locus of control and attribution styles. If a child feels that they have very little control over their schedule due to the parenting style they are exposed to, their locus of control will be external, a possible risk factor for the development of an anxiety disorder. Those with anxiety tend to have a global, stable, and internal attribution style; if there is a negative occurrence, they

imagine that every subsequent occurrence will always be negative and probably their fault. On the other hand, those without anxiety will be more likely to have a situational, fluctuating, and external attribution style, stating that if there is a negative occurrence, it only affects this one situation at this one time and may not be their fault; if it is their fault, they cope and work on fixing the situation. The third vulnerability is specific psychological vulnerability; this is how the anxiety disorders differentiate from the specific disorder (GAD vs. specific phobia, etc.). Barlow (2002) stated there are three ways of learning: observational, informational, and personal experience. It is possible to observe a frightening event happening to another person, which may then lead to the development of an anxiety disorder. One can also be informed via social media, the news, verbal discussion, or reading about a frightening incident. Finally, the event can be personally experienced, causing the disorder to develop.

Worry may be associated across many disorders defined in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) in addition to anxiety disorders due to high comorbidity (Kertz, Bigda-Peyton, Rosmarin, & Bjorgvinsson, 2012). It is defined in one study as “a chain of thoughts and images, negatively affect laden and relatively uncontrollable,” (Golden, et al., 2011; Borkovec, Robinson, Pruzinsky, & DePree, 1983, p 10). Those with GAD, which is generally a chronic disorder (Avdagic, Morrissey, & Boschen, 2014), may use worry to avoid threats they think are surrounding them both internally and externally. This type of coping style may allow them to avoid negative emotional reactivity (Newman et al., 2013). This theory is known as the Cognitive Avoidance model, posited by Borkovec and his associates (Borkovec, Robinson, Pruzinsky, & DePree, 1983). Because threats are related with one’s survival, it is important to decipher how to remove them. Worry allows a way of avoiding possible future threats, by thinking through possible situations and their negative outcomes (Borkovec et al.,

2004). Research has discovered two types of worry within people. *Type I worry* consists of thinking about and worrying about events and stimuli that are external and in the surrounding environment (Wells, 2005). This type of worry causes negative perceptions of worry, which then leads to *Type II worry*, which is worrying about worry, or meta-worry. This is covered in Well's metacognitive model and will be discussed further below.

Golden and colleagues (2011), studied worry in a population of community-dwelling older adults. They examined the difference between crippling worry found in those with generalized anxiety disorder and 'normal worry'. The interview used to assess their level of anxiety was the Geriatric Mental State (GMS; Copeland, Dewey, & Griffiths-Jones, 1986). Worry is common in this population, which may be generalized to other populations of older adults; however, only about 1/3 of those claiming to endure excessive worry met GAD criteria (Golden et al., 2011). This demonstrates that excessive worry may be evident without having met diagnostic criteria for an anxiety disorder. More therapeutic elements should be developed that focus specifically on worry, whether in both a clinical and non-clinical sample.

Those suffering from generalized anxiety disorder endure worries across a wide variety of concerns, such as finances, their own or a loved one's health, work, and relationships. There are specific negative beliefs that those suffering from GAD retain about these worries they are experiencing. One is that worry is uncontrollable, (Penney, Mazmanian, & Rudanycz, 2013) and that it is dangerous. These beliefs separate those with GAD from those with other anxiety disorders such as panic or social anxiety disorder. Penney and colleagues (2013) examined which beliefs about worry mediate trait worrying with GAD symptoms, hypothesizing that some participants in a nonclinical sample with high trait worry will develop these beliefs, further leading to the development of GAD, while participants without these beliefs will not. Their

study further expanded results of Borkovec and Ruscio's (2004) study, which posited negative beliefs about worries would relate more strongly to GAD symptoms than the positive beliefs when controlling for trait worry, to a nonclinical sample. Penney and colleagues (2013) found higher trait worriers are more prone to developing these negative beliefs about worry; therefore, the combination of these negative beliefs and high trait worrying equates these participants enduring more GAD symptoms (Penney et al., 2013).

**Risk Factors.** Four major risk factors determine the onset of GAD: environmental, attachment style, parenting style, and temperament. The environmental risk factors include sudden negative life events, which may cause people to worry about unexpected events occurring in their lives (Newman et al., 2013). People with anxiety also tend to have an external locus of control (Barlow, 2002). A child who develops an insecure attachment style (Bowlby, 1973) may be at higher risk for developing generalized anxiety disorder. Infants develop their attachment style based upon the parenting style to which they have been exposed; those with insecure attachment may have been exposed to either inconsistent, intrusive, or a variety of responses from their parental figure (Newman et al., 2013). Finally, the fourth risk factor, which is temperament, refers to innate responses by an infant toward their surrounding stimuli. Those with easily excitable temperaments may be at higher risk for GAD than those with a more inhibited temperament style (Newman et al., 2013) because their threshold for novel stimuli may be higher. This may also be due in part to how readily reactive they are toward external stimuli. Those with generalized anxiety disorder may also be suffering from somatic symptoms such as fatigue, nausea, sleeping problems, muscle tension, and/or headaches, (Cuijpers, et al., 2014). This disorder is considered to be chronic due to persistence after 6-12 years (Cuijpers et al., 2014).

Another characteristic of cognition in addition to extreme worry is rumination, which, similarly to worry, consists of cognitive processes involving repetitive, intrusive thoughts that may seem uncontrollable (Jong-Meyer, Beck, & Riede, 2009). Rumination is strongly comorbid with depressed mood characteristics, which are often comorbid with GAD symptoms. Rumination associates with metacognitive beliefs (Watkins & Baracaia, 2001). These beliefs may actually maintain the process of rumination. These findings are important because the current study focuses on metacognition; therefore knowing the relationship between anxiety and disorders found commonly comorbid with GAD is important to recognize.

**Treatments.** Medicine-based treatments, mindfulness treatments (more recently), and cognitive behavior therapy (CBT) have been examined as possible treatments for anxiety disorders (Newman et al., 2013). According to Borkovec and Ruscio (2001), CBT tends to be more beneficial than other treatments. Much of CBT treatment focuses on removing the avoidance behaviors patients have habituated to using, which sometimes includes worrying as a cognitive avoidance process (Borkovec et al., 2004). While those with GAD may feel that avoiding worry is a healthy step to recovery, avoiding their worry prevents them from experiencing the negative beliefs they hold are actually untrue (Wells, 2005). That experience would provide the knowledge that their negative beliefs are not actually harmful. CBT combines both cognitive treatment approaches, such as recognizing triggers, reconstructing some thoughts to be more realistic, and to recognize repetitive thoughts, and behavioral treatment approaches via exposure to the feared stimuli and the situations surrounding it. CBT may be more effective in the long term than relaxation exercises alone, which is used in treatment for anxiety disorders and does help short term (Cuijpers et al., 2014). CBT may actually be more effective for other anxiety disorders than generalized anxiety disorder (Avdagic et al., 2014). Acceptance and



commitment therapy (ACT; Hayes, 2004) is a new method based on CBT being developed in order to increase the amount of success in treating GAD. ACT, as it has been further developed, has become closer to CBT in nature, with a difference in theoretical psychopathology backgrounds (Avdagic et al., 2014). Whereas CBT proposes psychopathology develops because of dysfunctional thoughts and cognitions, ACT views development of the psychopathology to be based more on any type of avoidance (Avdagic et al., 2014).

Avdagic and colleagues (2014) compared the effects of ACT specifically on GAD with the effects of CBT. Both treatment types were expected to improve generalized anxiety symptoms, while ACT was expected to project higher improvements on measures focusing on avoidance. Great improvements with both treatment types were observed not only on anxiety levels, but depression and stress as well (Advagic et al., 2014).

**Metacognition.** Wells (2005) created the metacognitive model of GAD, the model used in the current study. The current study focuses on the mediating effect that metacognition has on generalized anxiety disorder and uses this model as a basis. Please see Fig.1 in the appendix.

While those with GAD hold both positive and negative beliefs about worry, the negative beliefs seem to be the driving force of the etiology (Wells, 1994). This model posits that the positive beliefs about worry are that, first, worry allows individuals to avoid threats via thinking about them futuristically. Second, they view worrying as a coping mechanism. This type of worry is considered to be *Type I worry*, which continues until the person's "worry goal" (i.e., the feeling that they have significantly coped) is met (Wells, 2005). While this type of worrying may lead to anxious feelings due to catastrophizing internal questioning, it also may lead to a decrease in anxiety when the "worry goals" are met, which is depicted by the arrow leading from emotion to *Type I worry* in Fig. 1. Once the person starts thinking negatively about their own

worry, whether this is because of societal ideologies or because the *Type I worry* caused negative consequences in emotional regulation, *Type II worry* begins. This brings about the behavior strategies and thought control, also depicted in the above figure. Those with GAD in order to “control or avoid the need to worry,” use behavioral strategies (Wells, 2005, p. 110). Thought control occurs when people endeavor to only think thoughts that will not be a trigger of worry for them, but because this is extremely difficult, when patients fail at this, the negative belief that worry cannot be controlled is only reinforced (Wegener, Schneider, Carter, & White, 1987; Wells, 2005). This model gives researchers the knowledge of what should be a focal point of their research on effective treatment methods of GAD.

The current study uses the metacognitive model to appraise the use of technology in the form of an iPhone application in order to allow users to worry intentionally. The two measures this project utilizes are the Metacognitions Questionnaire (MCQ; Cartwright-Hatton & Wells, 1997) and the Generalized Anxiety Disorder Questionnaire (GADQ-IV; Newman et al., 2002). Participants completed these measures prior to the use of the application and the three weeks following usage. Having participants worry intentionally should, using this model, demonstrate to them that worrying is not always uncontrollable and dangerous.

**Technology.** Technology is an ever-growing medium in our world. Televisions are getting larger and computers are getting smaller, bringing new devices into the world every year. It is rare to find an adult who does not carry their cell phone with them daily within an arm’s length. Most of these cell phones are smartphones, owned by about 80% as of 2010, (Eonta, et al., 2011) a figure that has recently increased to about 88% (Ruhde, et al., 2014). With the invention of smartphones, the invention of applications increased as addressed in the following settings.

### **Technology in the Field**

Technology has made its appearance in the field of psychology. Some clinicians have used technology to send patients reminders about treatments and appointments (Eonta et al., 2011). It has proven to be more cost effective while still providing empirically supported treatment to those in need (Newman, Szkodny, Llera, & Przeworski, 2011). There are possibly two manners by which these technology-based treatments can have a positive influence in the community of this field: an increase in knowledge and methods, and integration in multiple aspects of society (Eonta et al., 2011). Using mass media forums such as a social networking site or a television commercial/episode serves as an effective psychoeducation channel, allowing diverse populations to learn about mental health and to identify potential concerns in order to maintain a healthy lifestyle (Barak & Grohol, 2011). In addition, going to psychological therapy often has a stigma attached to it; technology, specifically cell phones, offers therapy hidden by a popular form of communication and entertainment, therefore possibly eliminating some of the stigma (Eonta et al., 2011).

Some of these web-based interventions also include self-help groups in the form of blog forums, where those in need can seek out help and stay anonymous if they so desire (Barak & Grohol, 2011). Barak and Grohol (2011) also stated that while internet treatment options have proven to be extremely helpful, they should not completely take the place of face-to-face interventions, but instead act as an enhancement.

Specifically, there have been technological treatments that focus on anxiety disorders. These are completed via desktop computers, laptops, certain websites, and some virtual reality treatments (Newman et al., 2011). Some online treatments for anxiety disorders have had comparable results with face-to-face therapy techniques (Andrews, Cuijpers, Craske, McEvoy, &

Titov, 2010). Some of these treatments include lessons, complete with homework assignments for the patient that incorporate methods of CBT. They sometimes include the help of a professional in the field, though many are self-guided (Andrews et al., 2010). The researchers used a database ([www.psychotherapyrcps.org](http://www.psychotherapyrcps.org)) that included different psychological treatments, including technology-based treatments to develop the meta-analysis. These electronic treatments allow access to treatment for those who may not physically be able to gain treatment otherwise due to location (e.g., rural) or lower socio-economic status (SES; Newman et al., 2011).

One computerized method of CBT treatment, *Beating the Blues*, lasted for eight weeks of 50 minute sessions and included homework assignments for patients to complete within the week (Proudfoot et al., 2004). Patients completed the sessions at a computer with a nurse near the room for safety precautions. The nurses were instructed to spend very little time with the patients, for those randomized to this therapy group were not to receive face-to-face therapy. These computerized methods of therapy delivery had positive outcomes and led to an improvement of depressive and anxious symptoms (Proudfoot et al., 2004).

With smartphone applications so easily accessible, it is reasonable that many of these applications will serve as a form of help for various mental illnesses. One study searched the available apps on the iTunes store that claimed to have some connection to anxiety and were coded for level of relevance, then examined to further determine which empirically supported treatments the applications contained (Ruhde, et al., 2014). A protocol with standards an application intended for therapy should meet does not exist, which may lead to a large amount of false information being absorbed by these application users. Ruhde et al. (2014) reported that 566 applications claimed to involve anxiety, yet after screening for those that cost money, those that were extremely irrelevant, and those that had been removed from the store, 75 applications

remained. The applications were examined for the following empirically supported interventions: assessment/self-monitoring, psychoeducation, progressive/applied relaxation, exposure, cognitive restructuring, stimulus control, acceptance/mindfulness, other relaxation techniques, insomnia/sleep/hygiene, and other (Ruhde et al., 2014). A standardized application model needs to be created to improve applications in the future. Internet-supported interventions, such as virtual reality therapy, online gaming therapy, and more connection via text message may be developed in the future (Barak & Grohol, 2011).

The application used in the current study was designed to implement most of the aforementioned interventions. The users have the responsibility of setting aside time in their day for their worries. This “worry time” is beneficial because it reinforces the users for not focusing on their worries every time they cross their mind by actually allowing them to worry. When a worry enters their thoughts, they are supposed to open the application, write it in the journaling feature, and push it out of their mind until the alarm sounds for their worry time. At this time they are allowed to sit and worry for the duration of the timer; they may also use the problem-solving feature to think through the worries if they desire. When the timer sounds, they are to complete different mood ratings provided in the application, using the charts and graphs present within the app. Ideally, after using the application, their overall feelings of anxiety and persistent worries will decrease. Based upon the metacognitive model of GAD, the “worry time” serves as a good exposure for participants to reconstruct their view of worry. Pushing the worries out of their mind until the designated time demonstrates that worry can be controlled; this will challenge their negative beliefs. Also, it was hypothesized by the developers that if participants used the problem solving feature, they would see that worrying can be beneficial to an extent and that it is not always dangerous. Finally, the application also will portray that the positive beliefs

of worry (that worry helps deal with threatening situations) is true when the worry is controlled. The application helps therapeutically by only allowing the participants to worry for the set amount of time they had set up earlier, instead of letting them worry until they felt internally satisfied. The current study used an undergraduate sample that met diagnostic criteria for GAD solely based on Penn-State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) scores, yet this application should be useable by any population. We used the measure Satisfaction Usability Survey (SUS; Rizi, Dimeff, Skutch, Carroll, & Linehan, 2011) to gauge how helpful participants viewed the application in 15 items.

Examining these topics is important in order to establish better therapeutic techniques. Knowing what worry does to the human mind and body allows for treatment techniques to be fine-tuned and focused (Borkovec, Alcaine, & Behar, 2004). Worry is common, and if there is more research focusing on how to manage it, the onset of disorders such as generalized anxiety disorder might be better prevented. Prevention is just as important as treatment, which can also be improved with further research into these topics. With the ever-growing field of technology affecting everyone, it is almost essential to learn to how further infuse the field with treatment methods. The current study not only examines the possibility of doing so, but also may create an avenue for those whom have not yet been diagnosed with GAD, but do worry often, to learn to control it and prevent the worry from becoming more severe.

### **Hypotheses**

The first hypothesis of the current study proposes that the participants who consistently use the Anxiety Break smartphone application for three weeks will demonstrate lower scores in the MCQ and GADQ-IV as compared to their pre-test scores on these measures. It is also believed that participants' frequency and intensity of worrying daily will decrease, set aside only

for the designated worry time they assign for themselves, and that their problem solving skills will increase with the help of the application. This will be examined using a change score analysis of the MCQ and GADQ-IV pre and post scores.

The second hypothesis of the current study posits that metacognition, specifically meta-worry, has a mediating effect on generalized anxiety disorder symptoms, which will be analyzed by examining the scores from each participant's responses to the questionnaires. If participants score high in the MCQ measure, the researchers expected to see higher scores on the GADQ-IV measure. Theoretically, after using the application, decreased scores on the MCQ will lead to decreased scores on the GADQ-IV.

## **Methods**

### **Participants**

Participants for the current study were recruited from the undergraduate and graduate student population of a large Midwestern university. Inclusion criteria included that all participants must be at least 18 years old, must be fluent in written and spoken English, must score at least a 50 on the phone screening PSWQ, and must have an iPhone of their own. Exclusion criteria stated they must not be enrolled in the Introduction to Psychology course offered on campus.

There was a larger number of participants in Time 1 ( $n = 26$ ). Eleven participants were randomly assigned to the waitlist and the remaining were assigned to the immediate group. After attrition at Time 2, 19 participants remained in the study and these same 19 participants were tested at Time 3.

### **Measures**

**Demographics.** Participants gave their age, gender, race, and ethnicity for demographic purposes.

**Penn State Worry Questionnaire. (PSWQ).** This measure was used for the phone screening to ensure that our sample consisted of high worriers, and served as the weekly questionnaire the participants completed in order to assess whether the application was actually decreasing worry levels. Scores on this measure determined the frequency and manner of participants' worries. An example question is "I do not tend to worry about things" with participants rating the questions as 1 - not at all typical of me to 5 - very typical of me. Higher scores indicate more worry. There are several reversed score items. (Meyer, Miller, Metzger, & Borkovec, 1990). This measure has been tested for reliability at a reliability coefficient of .86 (Hopko, et al., 2003).

**Generalized Anxiety Disorder Questionnaire DSM IV. (GADQ-IV).** This measure focuses on participants' worries and gauges their level of anxiety about such worries. There are fifteen items included. An example item is "During the last six months, have you often been bothered by excessive or uncontrollable worries more days than not," which participants would rate 0 - no and 1 - yes. For this measure, a few different question formats appear, each type containing another rating scale. This measure was used to correlate participants' worry levels with GAD symptoms. The more "yes" answers reported, the higher their worry levels (Newman et al., 2002). This measure has been tested for reliability at a reliability coefficient of .80 (Comer, Pincus, & Hofmann, 2012).

**Meta-Cognitions Questionnaire. (MCQ).** This measure also contains subsets: positive beliefs about worry (six items), uncontrollability (six items), and controlled thought (six items). The measure focuses on what beliefs patients have about the worry they are experiencing. An



example item is “I am constantly aware of my thinking,” with answers rating from 1 - do not agree to 4 - agree very much. Higher scores indicate higher degrees of meta-worry. This measure was used to examine mediation over GADQ-IV scores. (Wells & Cartwright-Hatton, 2004). This measure was found to have a good reliability with a reliability range of .72-.93 (Wells & Cartwright-Hatton, 2003).

### **Procedure**

Recruitment was accomplished through the posting of flyers on campus and in the surrounding community. The flyers gave the inclusion criteria, as well as the phone number and e-mail address for the research lab. Once the possible participants contacted the lab, one of three people would then conduct the phone screening, which consisted of five criteria questions and the Penn-State Worry Questionnaire’s sixteen measure items which the possible participants rated from 1-5 on how applicable the items were to their lives. If the callers scored a fifty or higher, a baseline assessment would be scheduled. Once scheduled, the researchers randomly assigned each participant to either the waitlist group or the immediate group (specifying at which point they would receive the smartphone application).

### **Time 1: Baseline**

At the baseline assessment, the researcher read a script about the study to the participant in the lab. The participant then signed the consent form before completing the survey through the Survey Monkey website. Once they completed the survey, the researcher opened the computer task for them, the Joorman task (data from this task is not used in the present study), and demonstrated what needed to be done for the task. After completion of the Joorman task, participants assigned to the waitlist group completed a payment form, scheduled a time for Time 2 assessment as well as a time to receive the weekly PSWQ survey, and were escorted from the

lab. Those assigned to the immediate group also completed the payment form, scheduled the next assessment times, and received the app to download on their phone. The researcher then explained how to use the app: how to set up the worry time, how to fill out the self-reports within the application, how to create a password, and how to e-mail the application data to the research lab. They, too, were escorted out at the end of the session. Each participant was e-mailed a link to complete the PSWQ for the next two weeks before returning for the Time 2 assessment.

### **Time 2**

At the Time 2 assessment, participants were once again greeted with the aforementioned verbal script before completing the Survey Monkey survey, which, for the most part, is a replica of the baseline assessment; however, those in the immediate group had an extra measure added to their survey to rate the actual application itself. After the survey, the Joorman task was administered once again. Following the Joorman task, those in the waitlist group then received the application and the tutorial of how to use it. Those in the immediate group were told to not use the application for the remainder of the study. The PSWQ was emailed to both groups once each week leading up to Time 3, which took place three weeks after Time 2.

### **Time 3**

At Time 3 (week 6), participants were e-mailed a link to another large Survey Monkey survey that could be completed at home. This time, those in the waitlist group received the extra measure. It was after Time 3 that participants scheduled a time to come into the lab and receive their payment.

### **Statistical Analyses**

The current study will examine scores in the MCQ and GADQ-IV using a change score analysis, specifically examining scores from baseline to Time 2. It is expected that the scores will decrease over time due to the app usage. Also, a mediation analysis will be run for each individuals' scores on those two measures. It is expected that scores will be positively correlated due to a mediating effect metacognition has on generalized anxiety disorder symptoms. These analyses were run to see if metacognition increases or decreases one's GAD symptoms.

## Results

A mediation analysis was run using the change scores derived by subtracting Time 2 MCQ and GADQ-IV scores from Time 1 MCQ and GADQ-IV scores. No significant results were found, indicating that, in this sample, metacognitive factors did not have a mediating influence on Generalized Anxiety symptoms.

The *a path* between the smartphone application and metacognitions score was not significant,  $F(2, 16) = 1.73, p = .58$ . This indicates that the application did not have an effect on the MCQ scores. The *b path* between metacognition and generalized anxiety disorder symptoms was also not significant,  $F(2, 16) = .173, p = .12$ . This suggests that metacognition, or at least the scores on the MCQ, do not have an effect on the scores on the GADQ-IV. The *c path* between the smartphone application and anxiety disorder symptoms was also not significant,  $F(2, 16) = 1.73, p = .42$ . This portrays no effect between the phone and the symptoms of GAD. Finally, the *c' path*, or the actual mediation path, was also nonsignificant,  $F(2, 16) = 1.73, p = .54$ . This means there was no direct effect on GADQ-IV scores by the application under the influence of the metacognition scores. Overall, 7.5% of the variance explained the change in the

## Discussion

No significant associations were found among A, B, C, or C' pathways. Metacognition did not, in this sample, mediate the symptoms of generalized anxiety disorder. Contrary to expectations, participants did not experience any decrease in worry symptoms by using the smartphone application. Currently, there is no set protocol application developers are required to follow before creating an application they claim will help decrease anxiety. Although we attempted to use empirically based-treatment ideologies when creating this application, the lack of a protocol may have contributed to the absence of significant findings. While we expected that the methods used in the application would decrease anxiety, the data does not support this.

Therefore, facets of the application itself may prove to be limitations of this study. Some of the participants mentioned that there were too many “alerts” set to go off, reminding them to complete various questionnaires. This may have induced anxiety instead of eliminating it. Also, the sample size was small; only 19 participants completed the six weeks of the study. A larger sample size may produce different results due to the greater variety of symptoms and scores. A third limitation was the lack of environmental control. Because the study took up six weeks of a semester, with different participants starting and finishing at various time points, the data reflects many moments in the semester. Some data is from the start, while others around mid-terms, and other data reflects feelings closer to final exam week. Because of this, results may not be a true reflection of how well the application can decrease symptoms of anxiety. Some points of the semester are more stressful than others. It may be interesting to examine if the application would actually help during these stressful points; future research may try a three-week study that consists of the week before finals, finals week, and the week after finals.

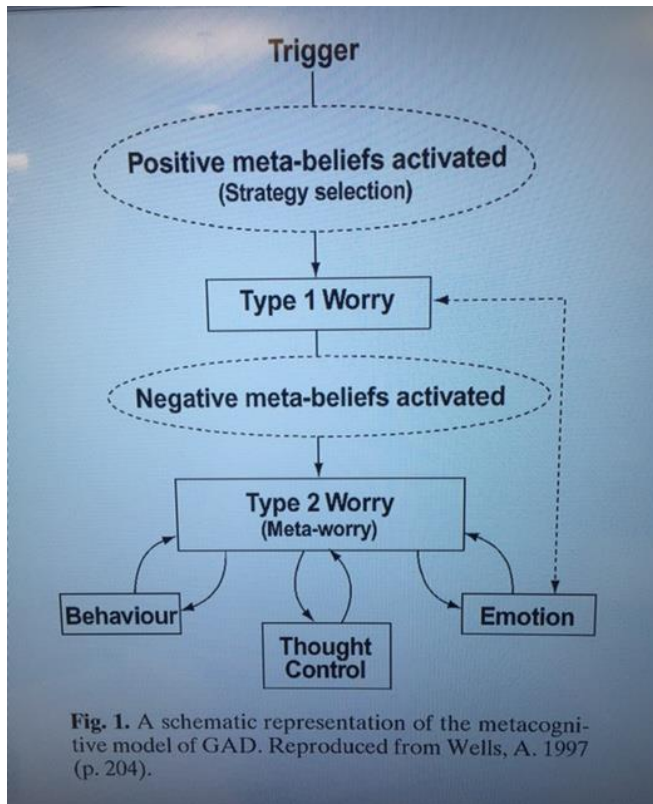
In the future, the study should either be shorter to eliminate the variance in the environment (as some participants completed Time 1 during midterms while others completed it

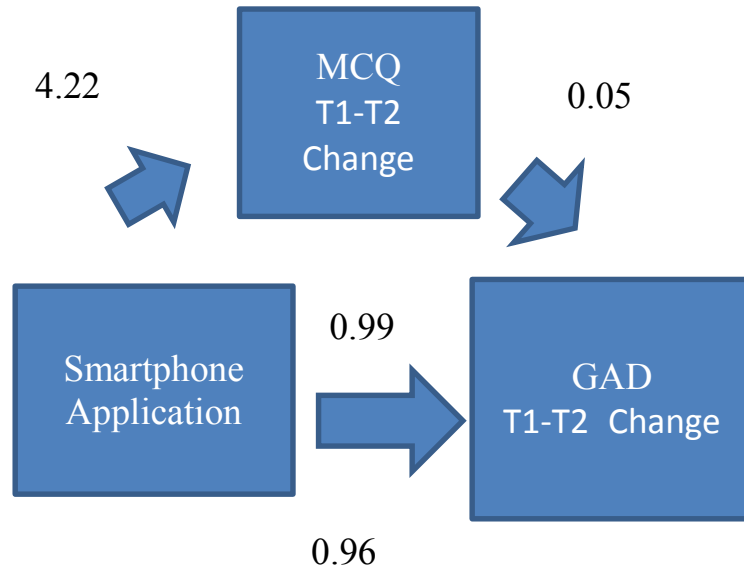
at the start of the semester) or should be longer, covering more of the semester and allowing better results. Also, it would be interesting to focus on other forms of anxiety (i.e. social anxiety, panic disorder, specific phobia). Third, testing other age groups would be useful information. Students currently in high school have grown up knowing and using this form of technology, while adults in their 30's-60's have not. It would be interesting to see if technology would be useful to those who did not grow up with it. Finally, developing a set of standards that developers must abide by when coding these applications is imperative. Researchers should work with Apple and Android to create some sort of protocol to follow. If users want to download an application that claims to aid in the reduction of anxiety, then the application should actually reduce anxiety.

## Appendix

Table 1. The mediating effect of Metacognition on GAD

<b>Mediators</b>	<b><i>a paths</i></b>		<b><i>b paths</i></b>		<b><i>Indirect Effect (SE)</i></b>	<b><i>Effects</i></b>	
	<b><i>b (SE)</i></b>	<b><i>t</i></b>	<b><i>b (SE)</i></b>	<b><i>t</i></b>		<b><i>95% C.I.</i></b>	
MCQ Change	4.2186	0.5682	0.0545	1.6526	0.6306	-0.26	2.41
<b>Predictor</b>	<b><i>c paths</i></b>		<b><i>c' paths</i></b>				
	<b><i>b (SE)</i></b>	<b><i>t</i></b>	<b><i>b (SE)</i></b>	<b><i>t</i></b>			
Application	0.9944	0.6248	0.9563	0.6248			

**Figure 1. Wells' Metacognitive Model**

**Figure 2. Mediation Model**



## References

- American Psychological Association. (2010). Anxiety. *American Psychological Association Website*. Retrieval date: 10/2/15.
- Andrews, G., Cuijpers, P., Craske, M.G., McEvoy, P., & Titov, N. (2010). Computer therapy for the anxiety and depressive disorders is effective, acceptable, and practical health care: A meta-analysis. *PLoS One*, 5(10), e13196.
- Avdagic, E., Morrissey, S.A., & Boschen, M.J. (2014). A randomized controlled trial of acceptance and commitment therapy and cognitive-behaviour therapy for generalised anxiety disorder. *Behaviour Change*, 31, 110-130.
- Barlow, D.H. (2002). *Anxiety and its disorders*. New York, NY: Guilford Press.
- Barak, A. & Grohol, J.M. (2011). Current and future trends in internet-supported mental health interventions. *Journal of Technology in Human Services*, 29, 155-196.
- Borkovec, T.D., Robinson, E., Pruzinsky, T., & DePree, J.A. (1983). Preliminary exploration of worry: Some characteristics and processes. *Behavior Research and Therapy*, 21(1), 9-16.
- Borkovec, T.D., Alcaine, O., Behar, E.S. (2004). Avoidance theory of worry and generalized anxiety disorder. *Generalized Anxiety Disorder: Advances in Research and Practice*, ed. R.G. Heimberg, D.S. Mennin, C.L. Turk, pp. 77-108. New York: Guilford
- Borkovec, T.D., & Ruscio, AM. (2001). Psychotherapy or generalized anxiety disorder. *Clinical Psychiatry* 62, 37-45
- Bowlby, J. (1973). *Attachment and Loss: Vol. 2 Separation*. New York: Basic Books
- Cartwright-Hatton, S. & Wells, A. (1997). Beliefs about worry and intrusions: The Metacognitions Questionnaire. *Journal of Anxiety Disorders*, 11, 279-315.

- Copeland, J.R., Dewey, M.E., & Griffiths-Jones, H.M. (1986). A computerized psychiatric diagnostic system and case nomenclature for elderly subjects: GMS and AGE-CAT. *Psychological Medicine*, 16, 89–99.
- Comer, J.S., Pincus, D.B., & Hofmann, S.G. (2012). Generalized anxiety disorder and the proposed associated symptoms criterion change for DSM-5 in a treatment-seeking sample of anxious youth. *Depression and Anxiety*, 29 (12), 994-1003.
- Cuijpers, P., Sijbrandij, M., Huibers, M., Berking, M., & Andersson, G. (2014). Psychological treatment of generalized anxiety disorder: A meta-analysis. *Clinical Psychology Review*, 34, 130-140.
- Eonta, A.M., Christon, L.M., Hourigan, S.E., Ravindran, N., Vrana, S.R., & Southam-Gerow, M.A. (2011). Using everyday technology to enhance evidence-based treatments. *Professional Psychology: Research and Practice*, 42, (6) 513-520.
- Golden, J., Conroy, R.M., Bruce, I., Denihan, A., Greene, E., . . . Lawlor, B.A. (2011). The spectrum of worry in the community-dwelling elderly. *Aging and Mental Health*, 15, (8) 985-994.
- Hayes, S.C. (2004). Acceptance and commitment therapy, relational frame theory, and the third wave of behavioral and cognitive therapies. *Behavior Therapy*, 35 (4), 639–665.
- Hopko, D.R., Reas, D.L., Beck, J.G., Stanley, M.A., Wetheroff, J.L., . . . (2003). Assessing worry in older adults: Confirmatory factor analysis of the penn state worry questionnaire and psychometric properties of an abbreviated model. *Psychological Assessment*, 15 (2), 173-183.

- Jong-Meyer, R., Beck, B., & Riede, K. (2009). Relationships between rumination, worry, intolerance of uncertainty and metacognitive beliefs. *Personality and Individual Differences, 46*, 547-551.
- Kertz, S.J., Bigda-Peyton J.S., Rosmarin D.H., & Bjogvinsson T. (2012). The importance of worry across diagnostic presentations: Prevalence, severity, and associated symptoms in a partial hospital setting. *Anxiety Disorders 26*, 126-33.
- Meyer, T.J., Miller, M.L., Metzger, R.L., & Borkovec, T.D. (1990). Development and validation of the Penn State Worry Questionnaire. *Behavior Research and Therapy, 28*, 487-495.
- Newman, M.G., Llera, S.J., Erickson, T.M., Przeworski, A., & Castonguay, L.G. (2013). Worry and generalized anxiety disorder: A review and theoretical synthesis of evidence on nature, etiology, and treatment. *Annual Review of Clinical Psychology, 29*, 275-97.
- Newman, M.G., Szkodny, L.E., Llera, S.J., & Przeworski, A. (2011). A review of technology-assisted self-help and minimal contact therapies for anxiety and depression: Is human contact necessary for therapeutic efficacy? *Clinical Psychology Review, 31*, (1) 89-103.
- Newman, M.G., Zuellig, A.R., Kachin, K.E., Constantino, M. J., Przeworski, A., . . .Cashman-McGrath, L. (2002). Preliminary reliability and validity of the GAD-Q-IV: A revised self-report diagnostic measure of generalized anxiety disorder. *Behavior Therapy, 33*, 215-233.
- Penney, A.M., Mazmanian, D., & Rudanycz, C. (2012). Comparing positive and negative beliefs about worry in predicting generalized anxiety disorder symptoms. *Canadian Journal of Behavioral Science, 45*, (1) 34-41.
- Proudfoot J., Ryden C., Everitt B., Shapiro D.A., Goldberg D., Mann, A...Gray, J.A. (2004) Clinical efficacy of computerised cognitive-behavioural therapy for anxiety and

- depression in primary care: randomized controlled trial. *British Journal Psychiatry* 185: 46–54.
- Purdon, C. (1999). Thought suppression and psychopathology. *Behavior Research and Therapy*, 37, 1029-1054.
- Rizi, S. L., Dimeff, L.A., Skutch, J., Carroll, D., & Linehan, M.M. (2011). A pilot study of DBT coach: an interactive mobile phone application for individuals with borderline personality disorder and substance use disorder. *Behavior Therapy*, 42(4), 589-600.
- Ruhde, D., Ran, D., Schrock, M., Habib, R., & Kertz, S. J. (2014). *A Review of Empirically Supported Components in iPhone Apps for Anxiety*. Poster presented at the annual meeting of the Anxiety Disorders and Depression Association of America: Chicago, IL.
- Watkins, E., & Baracaia, S. (2001). Why do people ruminate in dysphoric moods? *Personality and Individual Differences*, 30, 723–734
- Wegner, D.M., Schneider, D.J., Carter, S.R., & White, T.L. (1987). Paradoxical effects of thought and suppression. *Journal of Personality and Social Psychology*, 53, 5-13.
- Wells, A. (2005). The metacognitive model of GAD: Assessment of meta-worry and relationship with DSM-IV generalized anxiety disorder. *Cognitive Therapy and Research*, 29, 107-121.
- Wells, A. & Cartwright-Hatton, S. (2003). A short form of the metacognitions questionnaire: properties of the MCQ-30. *Behavior Research and Therapy*, 42, 385-396.

