ACCEPTABILITY AND EFFICACY OF A SINGLE SESSION REPETITIVE NEGATIVE THINKING INTERVENTION: A PILOT STUDY

by

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ABSTRACT OF THE DISSERTATION

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Repetitive Negative Thinking (RNT) is a cognitive process that is repetitive, passive/unproductive, difficult to control, and focused predominantly on negative content. RNT has been identified as a transdiagnostic risk factor associated with the development and/or maintenance of a wide variety of psychological disorders and problematic behaviors. While evidence-based treatments exist that address RNT in some way, they are limited in their ability to reach the wide range of individuals experiencing problems with RNT.

The present study sought to develop a single-session mindfulness-based skills-training video aimed at reducing RNT and assess its acceptability and preliminary efficacy across multiple methods. Participants, adult community members screened for high trait RNT (n = 71), completed baseline questionnaires and scheduled an in-person lab visit. Participants were randomly assigned to either the active (skills-training) or the control (no skills training) condition. The intervention's preliminary efficacy was then assessed by comparing the groups' levels of RNT and Negative Affect (NA): following an RNT induction during the lab visit, over the course of a five-day Ecological Momentary Assessment (EMA) monitoring period, and self-reported at follow-up relative

to baseline. The intervention's acceptability was assessed based on participants expectations at the end of the lab visit, their momentary reports of skills use and perceived effectiveness, and their retrospective satisfaction and perceived utility of the intervention at follow-up.

Overall, results were promising for the intervention. The active condition demonstrated statistically and clinically significant and reliable reductions in RNT and NA at follow-up compared to baseline. They also reported less RNT and NA and more frequent and successful skills use over the course of the EMA monitoring period. However, we were unable to assess the impact of the skills training immediately after training in the lab because the RNT induction failed to induce RNT or NA in either condition. Finally, active condition participants reported finding the intervention acceptable across all three assessment timepoints.

These finding indicate that a single-session mindfulness-based skills-training intervention is acceptable and potentially efficacious in reducing RNT. Together with the intervention's preliminary promise, its brevity, low cost, ability to be delivered online, and applicability to a wide range of populations, make this a promising intervention that warrants continued investigation, development, and refinement.

DEDICATION

I would like to dedicate this dissertation to my Mom and Dad, Catherine Hughes and Jack Weible. Without their endless and unconditional love and support none of what I have accomplished would have been possible.

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I. Introduction

Repetitive Negative Thinking

Individuals can respond to distress and problems in a variety of ways resulting in a wide range of outcomes. For some, thinking about negative content (current concerns, problems, past experiences, feared futures, etc.) often becomes repetitive, uncontrollable, difficult to disengage from, and unproductive. This repetitive negative thinking (RNT) has been proposed as a transdiagnostic process involved in the development and maintenance of a wide variety of psychological disorders (Ehring & Watkins, 2008; Harvey, Watkins, Manse, & Shafran, 2004).

The construct of RNT encapsulates several of what were initially—and still are by some—considered discrete, disorder-specific cognitive processes distinguished by the particular content on which the thinking focuses (Ehring & Watkins, 2008). The specific foci of RNT have been outlined in a vast number of psychological disorders; for example, on depressive symptoms in depressive rumination (Nolen-Hoeksema, 2004); about future negative events in generalized anxiety disorder (GAD)'s worry (Borkovec, Robinson, Pruzinsky, & DePree, 1983); on past traumas in posttraumatic stress disorder (PTSD)'s traumatic rumination (Michael, Hilligan, Clark, & Ehlers, 2007); on distressing social situations in social anxiety disorder's post-event rumination (Clark & Wells, 1995); on physiological sensations in panic disorder's catastrophic misinterpretations (Clark, 1986); on emotional distress in borderline personality disorder (BPD)'s emotional cascades (Selby & Joiner, 2009); on obsessions and compulsions in obsessive compulsive disorder (OCD; Abramowitz, Whiteside, Kalsy, & Tolin, 2003); on perceived physical flaws in body dysmorphic disorder (BDD; Arditte, Shaw, & Timpano, 2016); on health concerns in hypochondriasis (Fink, Ornbol, Roft, Sparle, Frostholm, & Olsen, 2004); on sleep in insomnia (Harvey, 2002); and on delusions in psychotic disorders (Morrison & Wells, 2007). Additionally RNT is believed to play a role in other disorders and behavioral problems such as disordered eating (Nolen-Hoeksema, Stice, Wade, & Bahon, 2007), substance use disorders (Hilt, Armstrong, & Essex, 2015), suicidal thoughts and behaviors (Williams, Fennell, Barnhofer, Crane, & Silverston, 2015), and problematic anger (Peled & Moretti, 2010). The current definition of RNT is based on the common factors shared between other definitions/conceptualizations: a thinking process that is repetitive, passive, relatively uncontrollable, and focused predominantly on negative content (Ehring & Watkins, 2008).

Whether or not different forms of RNT (e.g., depressive rumination) are actually distinct constructs/processes is still a subject of debate. However, the fact that they share common elements seems to be supported by enough empirical data (Ehring & Watkins, 2008; Topper, Emmelkamp, & Ehring, 2010; Watkins, 2008) to proceed with the development of interventions targeting RNT as a transdiagnostic mechanism by targeting the shared elements in the process(es) of RNT. Despite the fact that the majority of empirical studies have focused on specific forms of RNT (i.e., worry and rumination), the effects have been relatively similar across disorder-specific forms.

As outlined in several review papers (Lyubomirsky & Tkach, 2004; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Watkins, 2008) experimental manipulations of rumination and worry have produced a relatively consistent pattern of results, robust across a wide range of study methodology and populations sampled. Specifically, regarding rumination, researchers have demonstrated that it leads to: increased negative affect (NA; general NA, depression, anxiety, and anger); negatively biased thinking; negatively biased and overgeneral autobiographical memory recall; impaired problem solving and increased negative thinking about the future; decreased motivation and inhibition of effective responses; dysfunctional interpersonal behaviors (e.g., aggressive, dependent, and clingy interpersonal styles); and impaired cognitive performance and concentration. While fewer in number, experimental manipulations of worry have found similar effects, such as increased NA, increased physiological indices of anxiety (e.g., increased heart rate, blood pressure and galvanic skin response), more intrusive thoughts, impaired problem solving, increased threat expectancies, delayed sleep onset, and avoidance of social interactions (see Topper et al., 2010 and Watkins, 2008 for reviews).

Additionally, the processes believed to contribute to the development and maintenance of RNT appear to be more similar than different across disorders (see Ehring & Watkins, 2008 for a review). The content of RNT appears to be more verbal than image-based in studies investigating the content of thought in worry, depressive rumination, PTSD and insomnia, and RNT more broadly (Ehring & Watkins, 2008). While potentially beginning with more specific/concrete thoughts, RNT generally tends to be characterized by abstract/general information processing, and the abstract content is what is believed to be responsible for several of the negative consequences outlined above. Meta-cognitive beliefs (i.e., beliefs about RNT's utility and danger) are also believed to play a role in the onset of RNT cycles (particularly positive meta-cognitive beliefs) and of dysfunctional responses (e.g., thought suppression) to escape them (particularly negative meta-cognitive beliefs), and is the foundation of meta-cognitive therapy, a treatment for RNT that has been applied in the context of both anxiety (Wells, 2010) and depressive (Wells & Papageorgiou, 2004) disorders.

Recently, studies using structural equation modeling have found that models containing RNT as a single construct (compared to separating rumination and worry) produced better fitting models in both cross-sectional and predictive studies (Arditte, Shaw, & Timpano, 2016; Topper, Molenaar, Emmelkamp, & Ehring, 2014). Furthermore, when non-clinical participants were asked to describe rumination and worry (the two most common terms used to describe RNT), their descriptions shared far more similarities than differences (Papageorgious & Wells, 1999; Watkins, 2004; Watkins, Moulds, & Mackintosh, 2005). Based on these findings, interventions designed to address RNT may be unnecessarily complicated by targeting specific disorder/populations or distinguishing between specific types of RNT.

Established RNT Interventions

There are a number of established, evidence-based treatments that address RNT either as part of a larger treatment package (e.g., Behavioral Activation; Dimidjian et al., 2006) or as the primary target of treatment (e.g., Attention Training Treatment; Wells, 2000). While each treatment described below shares the common target (whether primary or one of many) of reducing RNT and have demonstrated efficacy, they do so in very different ways based on distinct theoretical foundations. Additionally, several established treatments address RNT in the context of specific disorders (e.g., Rumination Focused Cognitive Behavioral Therapy for Depression; Watkins, 2016) and have yet to demonstrate efficacy in the context of other disorders. However, the majority of these studies assessed RNT using retrospective self-report measures designed to assess trait-level RNT (e.g., the RRS; Treynor, Gonzalez, & Nolen-Hoeksema, 2003), making it difficult to discern interventions' overall effects on RNT (e.g., its frequency, impairment, and distress). Below is a brief summary of the interventions that have demonstrated at least some potential for reducing RNT.

Cognitive Therapy (CT): One common approach to reducing RNT is through cognitive restructuring, in which clients are taught to change the content of their RNT by identifying and challenging erroneous and dysfunctional beliefs (Beck, 2011; Dimidjian et al., 2006; Purdon, 2004). In the context of fear-based disorders (anxiety, obsessive-compulsive-related, and trauma-related disorders), recent research has shifted the theoretical emphasis of Cognitive Behavioral Therapy (CBT)'s mechanisms of action from the cognitive aspects (i.e., restructuring) to the behavioral components (i.e., exposures; Arch & Craske, 2009; Borkovec, Alcaine, & Behar, 2004; Douglas, Gagnon, Ladoucer, & Freeston, 1998). However, there is little to no empirical support for the use of exposures in the context of depressive disorders or other problematic behaviors related to RNT (e.g., suicidal thoughts and behaviors). Historically a broader limitation of CT has been its complexity, which does not lend itself well to mass dissemination or brief intervention adaptations in the same way as other treatment approaches like behavioral activation do.

Behavioral Activation (BA): In BA for depression (Martell, 2001), rumination is targeted by self-monitoring, identifying situations in which clients typically ruminate, conducting functional analyses of behavior on rumination episodes, and planning alternative behaviors to use when clients find themselves ruminating (i.e., attention to their present experiences—similar to that of mindfulness; Dimidjian et al., 2006; Kanter et al., 2010; Jacobson, Martell, & Dimidjian, 2001). However, major RCTs of BA (e.g., Dimidjan et al., 2006) have not directly assessed rumination and therefore it is uncertain the extent to which rumination decreases as a result.

Competitive Memory Training (COMET): COMET is a brief transdiagnostic protocol targeting RNT developed in the Netherlands (Ekkers et al., 2011; Maarsingh, Korrelboom, & Huijbrechts, 2010). The aim of COMET is to reduce the amount of involvement clients have with the thoughts and emotions tied to RNT. Clients are taught to prepare and activate counter memories (ones in which they were indifferent or accepting) when RNT comes up. COMET begins with enhancing motivation to stop RNT with psychoeducation, and helping clients identify the frequency and themes where they engage in RNT. Then, they are helped to develop counter memories, ones of instances where they successfully disengaged from RNT, and imagine doing so again the next time they begin to engage in RNT. Efficacy of COMET has been most widely studied and supported in the context of depression/depressive rumination (Ekkers et al., 2011), but has also demonstrated some preliminary success in the treatment of RNT in the context of OCD (Schneider, Wittekind, Talhof, Korrelboom, & Moritz, 2014) and psychosis (van der Gaag, van Oosterhout, Daalman, Sommer, & Korrelboom, 2012).

Attention Training Treatment (ATT): ATT is another brief transdiagnostic protocol targeting RNT (Wells, 2000). The goal of ATT is to enhance clients' ability to control their attention in the service of redirecting their attention from self-focused (RNT) to externally-focused stimuli. Attentional control is trained by having clients practice selective attention, attention switching, and divided attention in a series of audio-based training exercises. Clients are then instructed to treat RNT thoughts the same way as they do the “noise” when they are practicing shifting their attention. ATT is applied in the same manner regardless of the disorder-specific RNT it is targeting. ATT has demonstrated efficacy in the reduction of RNT in a variety of disorders including panic (Wells, 1990), psychosis (Wells, 2007), hypochondriasis (Papageorgiou & Wells, 1998), and GAD (Amir, Beard, Cobb, & Bomyea, 2009), with the majority of its empirical support in the context of depression (Wadlinger & Isaacowitz, 2011; Wells, 2000).

Rumination Focused CBT (RFCBT): RFCBT is a specific CBT protocol aimed at reducing depressive symptoms by targeting RNT specifically (Watkins, 2016). RFCBT differs from more traditional CBT’s approach to RNT in that it attempts to modify clients’ thought processes rather than the content of thoughts themselves. RFCBT’s consists of 12 individual sessions in which clients are taught to distinguish between and shift from unconstructive self-focused attention (RNT) to constructive self-focused attention (e.g., problem solving) via psychoeducation, functional analyses of past rumination, behavioral experiments, and experiential and imagery exercises (Watkins, 2016; Watkins et al., 2011). Preliminary studies (one case series and one RCT) have supported its efficacy in the treatment of residual symptoms of depression assessed using standard self-report depression questionnaires (Watkins et al., 2007; Watkins et al., 2011). However, it remains unclear if RFCBT would be efficacious in addressing RNT in the context of other disorders or non-clinical populations.

Mindfulness-based Therapies: Mindfulness refers to the intentional focusing of one’s attention to the present moment’s experiences in a nonjudgmental, accepting, unattached, and curious manner (Kabat-Zinn, 2003). Many treatment approaches have begun to incorporate mindfulness as a component in the last several decades and have demonstrated efficacy in treating a relatively broad range of psychological disorders (Baer, 2006). While sometimes used as a standalone basis for treatment (e.g., Mindfulness Based Stress Reduction; Kabat-Zinn, 1990), mindfulness has also become a popular component in CBT protocols, leading some to refer to them as the “third wave” of CBT.

While not the explicit target of all mindfulness-based interventions, an emerging body of literature seems to point to reductions in RNT as a mediator in the initial and sustained reduction in symptoms of depression (Alleva, Roelofs, Voncken, Meevissen, & Alberts, 2014; Deyo, Wilson, Ong, & Koopman, 2009; Heeren & Philippot, 2011; Kearns, et al., 2016; Petrocchi & Ottaviani, 2016; Royuela-Colomer & Calvete, 2016; Ramel, Goldin, Carmona, & McQuaid, 2004) and anxiety (Desrosiers, Vine, Klemanski, & Nolen-Hoeksema, 2013; Kopelman-Rubin, Omer, & Dar, 2017; Topper, Emmelkamp, Watkins, & Ehring, 2017), supporting both the utility and feasibility of targeting RNT with mindfulness-based interventions. Several laboratory-based studies have directly compared the effects of rumination and mindfulness to other inductions (distraction, acceptance, positive reappraisal, and/or distancing; Arch & Craske, 2006; Broderick, 2005; Huffziger & Kuehner, 2009; Singer & Dobson, 2007) finding that mindfulness inductions lead to lower levels of distress and other problematic outcomes (e.g., avoidance and cognitive impairment).

Additionally, three ambulatory assessment studies have provided preliminary evidence that RNT inductions led to greater levels of distress than that of mindfulness inductions (Huffziger et al., 2013; Huffziger, Ebner-Priemer, Koudela, Rienhard, & Kuehner, 2012; Moberly & Watkins, 2008). Brief (4-to-6-week) mindfulness-based therapies have been found to be more effective than somatic relaxation (Jain, et al., 2007) and cognitive reappraisal (Keng, Smoski, & Robins, 2016) trainings in reducing distress and RNT in the context of anxiety and depression. Finally, two laboratory-based studies have demonstrated superiority of brief mindfulness trainings in the reduction of RNT and associated distress compared to distraction and problem solving (Hilt & Pollak, 2012), and progressive muscle relaxation and loving-kindness meditation (Feldman, Greeson, & Senville, 2010). The fact that even brief (in-lab inductions) mindfulness trainings can effectively reduce the effects of RNT, while only assessed in the short-term, is promising for the potential of mindfulness to be adapted from full packages of treatment into briefer interventions.

Mindfulness-Based CBT (MBCT; Segal, Williams, & Teasdale, 2002) is a treatment protocol integrating CBT and mindfulness principles into an 8-week group therapy program. Originally developed to prevent relapse in chronically depressed patients (Segal et al., 2002) it has also been found to reduce depressive symptoms in currently depressed (Shahar, Britton, Sbarra, Figueredo, & Bootzin, 2010) and nonclinical (Kaviani, Javaheri, & Hatami, 2011) samples as well as in the treatment of suicidal thoughts and behaviors (Williams, Fennell, Barnhofer, Crane, & Silverton, 2015), severe health anxiety (McManus, Muse, Surawy, Hackmann, & Williams, 2015), and PTSD symptoms (King et al., 2013). MBCT aims to reduce negative affect by reducing the frequency, impact, and engagement with negative thinking (originally rumination, though recent studies in non-depressed populations suggest it may be reducing RNT more generally). In MBCT patients are trained to recognize and disengage from RNT using mindfulness to pay attention to their internal experiences and the present moment in a decentered, nonjudgmental, and accepting manner via a variety of group and homework-based mindfulness activities (Segal et al., 2002). A recent RCT demonstrated that both increased daily mindfulness and reduced rumination mediated the effects of MBCT on depressive symptoms (Shahar et al., 2010).

Metacognitive Therapy (MCT): MCT (Wells & Papageorgiou, 2004) is a transdiagnostic treatment approach targeting RNT based on the metacognitive model of emotional disorders. In the metacognitive model, RNT is believed to be maintained by both positive and negative metacognitive beliefs where positive beliefs (that RNT helps understand and/or avoid problems) initiate RNT and negative beliefs (that RNT is dangerous/harmful), which become activated during RNT, then lead individuals to engage in dysfunctional attempts to stop/avoid RNT (e.g., thought suppression and avoidance) and increased distress (Wells & Papageorgiou, 2004). MCT aims to reduce RNT and related metacognitive beliefs through psychoeducation about RNT and metacognitive beliefs, skills training in thought control and alternative responses to RNT (i.e., attention training therapy and detached mindfulness respectively), and getting patients to commit and practice not engaging in RNT (Wells & Papageorgiou, 2004).

Several RCT and meta-analyses (Normann, van Emmerik, & Morina, 2014; Sadeghi, Mokhber, Mahmoudi, Asgharipour, & Seyfi, 2015; Wells, 2010) have demonstrated MCT's efficacy in the treatment of depression (Hagen et al., 2017), GAD (McEvoy et al., 2015), PTSD, and OCD in comparison to both waitlist-controls and TAU (i.e., CBT and relaxation training). One study found MCT to be superior to MBSR in the treatment of depression and anxiety (Capobianco, Reeves, Morrison, & Wells, 2018). While both treatments were found to be acceptable, feasible, and effective, these results suggest that mindfulness training without the other components of MCT (i.e., psychoeducation, alternative skills training, and commitment to not engage in RNT) may be less effective in addressing RNT.

Briefer Interventions

In their review of RNT, Ehring and Watkins (2008) suggested that one important future direction of research on RNT is the development and evaluation of transdiagnostically applicable strategies and interventions. Several of the treatments outlined above are promising approaches to reducing RNT. However, many of them are limited in their potential to reach the wide range of individuals experiencing problems associated with RNT in several ways. First, while many of them contain components targeting RNT, they are part of much larger, multifaceted treatment protocols and their ability to reduce RNT in isolation from the rest of their packages remains uncertain. Second, many of the treatment protocols are relatively long-term, often lasting several months, which means it may take substantial time for individuals to reap the benefit from treatment. Third, many of the treatments targeting RNT are focused on RNT in the context of specific disorders. Given the transdiagnostic nature of RNT, restricting the scope of RNT interventions to specific disorders may unnecessarily limit their reach. Additionally, the focus of RNT interventions on clinical populations means they may not reach non-treatment-seekers who could still be suffering the ill effects of RNT (Topper et al., 2010). Based on these limitations, the aim of the present study is to develop a brief, single-session, skills training intervention aimed at reducing RNT in a community sample of individuals experiencing problems associated with RNT regardless of diagnostic or treatment status.

To date, empirically tested brief RNT interventions are scarce, however, those studied have had promising initial results. One such intervention is a two-session RNT-focused Acceptance and Commitment Therapy protocol assessed in the treatment of moderate emotional disorders (Ruiz et al., 2018). A multiple-baseline study of 10 adults with elevated depression or anxiety scores, found that nine of the ten exhibited clinically significant changes in levels of depression and anxiety over the three-month follow-up period, and that these decreases were moderated by decreases in RNT (Ruiz et al., 2018). Another such intervention, an online two-week self-guided mindfulness-based intervention, has demonstrated superiority (decrease in RNT, depression, and anxiety symptoms) to a control condition in two studies using student samples (Cavanagh et al., 2013 & 2018). While these studies speak to the promise of briefer interventions to reduce RNT, further research on this type of intervention is necessary.

Topper and colleagues (2010) outline criteria for the development of preventative interventions targeting the transdiagnostic mechanism of RNT. They stated that interventions should be: 1) based on a clear theoretical model; 2) applicable to both worry and rumination; and 3) relatively brief and easily disseminable (e.g., group or online format). Single-session interventions, specific, structured interventions intentionally involving only one encounter or interaction with provider or program, represent the extreme end of this third criteria and have received an increasing amount of attention from researchers and clinicians in recent years (Schleider & Weisz, 2017; Sung, Dobias, Schleider, 2020). Single-session interventions have been described as “a particular variety of evidence-based kernels strategically fragmented to help maximize scalability and ensure that clients receive a full dose of the intended treatment every time” (Sung et al., 2020, p. 2). Given their brevity and potential for electronic-delivery, single-session interventions have the potential to overcome several of the aforementioned barriers to traditional psychological interventions (Schleider & Weisz, 2017), and some preliminary research has supported their potential for long-term therapeutic effects on youth internalizing psychopathology (Schleider, Abel, & Weisz, 2019). Researchers have identified two common features of empirically supported single session interventions: 1) they are mechanism-targeted, or theoretically based interventions carefully constructed to address specific maladaptive beliefs or behaviors thought to underlie the target problem; and 2) they target population-specific needs (Schleider & Weisz, 2017). As most single session interventions target problems with established treatments, they have been suggested not as replacements to established treatments, but rather, as simpler, lower cost alternatives that can be used as an adjunctive support, as a low-intensity first-line intervention within a stepped-care treatment, and/or as standalone interventions to alleviate symptoms in settings/populations where established treatments are not readily available (e.g., administered to patients put on a clinic's waitlist; Schleider et al., 2020).

We used criteria similar to that suggested by Topper et al., (2010) and Schleider and Weisz (2017) in our present attempt to develop a single-session intervention to reduce RNT. Specifically, we believe effective brief interventions for RNT should be based on treatments, or components of treatments that 1) target RNT broadly and are empirically supported for a range of populations; 2) are relatively short or at least simple enough to have their major component(s) taught in a single session; and 3) are simple enough to be understood by individuals with a wide range of intellectual functioning/cognitive ability with brief (under an hour) instructions. Another relevant element of simplicity is that they should be non-idiographic in nature, adding to their potential for cost effective and broad-reaching mass dissemination (e.g., provided via internet).

Based the extant treatments reviewed, we identified a number of elements that seem both central to their efficacy and feasible to incorporate into a brief intervention. The present study's intervention included: 1) psychoeducation about the definition of RNT, which addresses positive beliefs about RNT (i.e., reasons many people engage in RNT), and explains why RNT is generally ineffective; 2) an element of tracking RNT to facilitate an increased awareness of participants' RNT; 3) commitment to address RNT when it comes up; and 4) skills to use in response to RNT. The skills training component drew on elements of mindfulness and attentional control training.

Present Study/Intervention

One treatment not outlined in the earlier section that we believed had utility in the present study was DBT-ACES. Dialectical Behavior Therapy for Accepting the Challenges of Exiting the System (DBT-ACES; Comtois et al., 2014) is a 1-year add-on to standard DBT, specifically focusing on re-gaining employment as part of the recovery process for individuals with BPD (Comtois et al., 2014). It contains a specific skill centered around using mindfulness to control attention (specifically to respond to RNT with alternative behaviors, i.e., the "three mindful ways") using handouts and skills training instructions adapted from standard DBT and MBCT (Linehan, 2015; Segal et al., 2002). Clients are taught to use mindfulness as a tool to respond to RNT. First, they are provided with an explanation of what RNT is and why it is often ineffective. Then, they engage in a discussion about the negative consequences of their RNT. Next, mindfulness is introduced as an incompatible behavior to RNT and the clients are taught the “three mindful ways” as specific mindful alternatives to RNT. They are: 1) to break out of RNT using a formal mindfulness exercise (e.g., observing the breath, or taking a mindful walk); 2) to bring/anchor their attention to their current activity using the what and how skills (particularly one-mindfully and participate; Linehan, 2015); and 3) to do a mindful assessment of the situation, using relevant skills (e.g., what, how, check the facts, problem solving, & cope ahead) to determine the effective response to the problem. Finally, clients are to identify contexts (locations, circumstances, etc.) in which they often fall into patterns of RNT, topics or subjects that tend to prompt RNT for them, and brainstorm potential cues to prompt them to check-in and assess whether they are engaging in RNT (e.g., phone alerts, or tying a string to their finger; Comtois et al., 2014).

DBT-ACES has demonstrated feasibility and preliminary efficacy as an adjunct to standard DBT in an uncontrolled trial (Comtois, Kerbart, Atkins, Harned, & Elwood, 2010). However, there has been limited research on the treatment, with no direct measurement of its effect on RNT. The fact that it targets RNT broadly, contains many of the elements of an ideal single-session skills training outlined above, and is modular, speaks to the promise of this skills training module in adaptation to a brief, standalone, intervention targeting RNT. This promise is further supported by the fact that DBT skills more broadly have been adapted to standalone brief skills training interventions and have demonstrated efficacy in doing so (Ward-Ciesielski, 2013; Ward-Ciesielski, Tidik, Edwards, & Linehan, 2017).

The skills training used in the present study was adapted primarily from the DBT-ACES “mindfulness to control attention” skills training. Participants watched a 30-minute video in which they were first provided psychoeduation (what is RNT, why do people do it, why it is generally ineffective, warning signs to watch for, and how to catch themselves when they are engaging in RNT). Next, they were taught about mindfulness and how it is incompatible with RNT. Next, they were given instructions on how to use two different mindfulness-based exercises (observing the breath and one-mindful action) when they find themselves ruminating when they are idle and when they are supposed to be doing something else. Each skill was then practiced (observing the breath with guided mindfulness instructions and eating a raisin one-mindfully to practice one-mindful action). Finally, participants were asked to identify and write down “red-flags” to help them notice when they are engaging in RNT, contexts in which to be “on guard” for RNT, and plan cues to remind them to check in on themselves to see if they are engaging in RNT. The skills training for the present study was highly similar to the above described module of DBT-ACES, with the notable exception that the third mindful way was not included. We felt that this was too complex (based on using other skills taught in standard DBT/DBT-ACES) to be included in a brief single-session intervention. We chose to focus on the simpler, shorter-term solutions to RNT with the hopes that this might lead to more immediate skills use and reduction in RNT-related problems/distress. However, we acknowledge that without the longer-term alternatives to RNT, the skills training of the present study may not represent a comprehensive, long-term intervention for RNT.

The primary aim of the present study was to assess the acceptability and immediate and short-term effects of our novel, single-session, video-based, skills training intervention for RNT. To do so, we recruited individuals from the community screened for high trait rumination and/or worry. They were randomly assigned to either the active condition, in which they received one-session skills training, or the control condition, in which they received no skills training. During a lab visit, after the active condition's skills training, both conditions underwent an RNT induction after which their RNT and affect were measured and compared to assess the immediate effects of the skills training. Then, in order to assess the intervention's short-term effects, all participants completed a five-day EMA monitoring period during which their RNT, affect, and skills use were assessed several times per day. Short-term effects of the intervention were also assessed using baseline (pre-skills training) and follow-up (post-EMA phase) changes in RNT scores assessed via self-report questionnaires. Finally, acceptability of the intervention was assessed in the immediate term via an expectancy questionnaire administered in lab, as well as by an acceptability questionnaire administered during follow-up assessment.

We hypothesized that, compared to the control condition, the active condition participants would: 1) exhibit lower levels of RNT a) during the lab visit following an RNT induction, b) over the course of the EMA monitoring period, and c) at follow-up relative to baseline; 2) report lower levels of NA a) following the RNT induction, and b) over the course of the EMA monitoring period; and 3) rate the intervention as acceptable, as indicated by a) their expectations at the end of the lab visit, b) their momentary reports of skills use, c) their retrospective perception after a week of practice at follow-up, and d) their retrospective reported use of the skills at follow-up.

II. Method

Procedure

Participants were recruited via flyers (see Appendix 1) posted in the local community and University campuses, as well as online ads posted on Craigslist and local websites. Flyers instructed interested individuals to follow a link to a screening survey, which contained a description of the study, questions assessing inclusion and exclusion criteria, measures of trait rumination (the Brooding subscale of the Ruminative Responses Scale; RRS-B; Treynor et al., 2003) and worry (the Brief Penn State Worry Questionnaire; B-PSWQ; Topper, Emmelkamp, Watkins, & Ehring, 2014), and a space for them to provide contact information. Eligible participants were then sent an email with a link to a the pre-lab visit survey, containing an informed consent and baseline questionnaires (see measures and materials section below), after which they were redirected to a scheduling website to select a time for their in-person lab appointment.

Upon arrival to the lab, research assistants (RAs) reviewed and signed the informed consent with participants, after which they were randomly assigned to either the active or control condition. Participants in the active condition were then asked to fill out a measure of momentary affect and RNT, and then watched the skills training video (see Appendix 2). Next, all participants (both conditions) completed another momentary affect and RNT questionnaire, before going through a rumination induction (described in the measures and materials section below). Then, all participants completed another momentary affect and RNT questionnaire, followed by a five-minute rest period, where the active condition was instructed to practice the skills taught in the video and the control condition was given no specific instructions on what to do other than not use their phones and wait until the RA returned. After the rest period, all participants completed another momentary affect and RNT measure, and the active condition was asked to complete an expectancy questionnaire (described in the measures and materials section). Finally, RAs helped all participants install the EMA app and practice filling out a sample survey.

Beginning the day after their lab visit, all participants completed five days of EMA monitoring. All EMA assessments were administered using the LifeData software platform. Participants were prompted to respond to six signal-contingent entries each day for five days, yielding a total of up to 30 EMAs per participant. The prompts were scheduled to signal participants at random times within six 150-minute time intervals from 9:00 AM to 11:00 PM, and participants had one hour to respond to each prompt before it expires receiving a reminder every 15 minutes until they responded or he hour of eligibility expired. Each EMA contained a brief survey assessing their momentary affect, RNT, and skills use (see measures and materials section for full description). All responses were timestamped and uploaded to a secure server where researchers could view and download the data.

After the EMA monitoring period, participants were sent an email with a link to another set of self-report questionnaires similar to that of their pre-lab survey. Participants in the control group were also offered to have the skills training video shown to the active condition sent to them. Upon completing the final survey, participants were provided compensation for their participation in the form of an Amazon gift card sent via email. Participants were compensated up to $50 ($15 for the lab visit, $0.50 for each EMA response [six per day for 5 days totaling up to $15], and an additional $20 if they completed 80% or more of the EMA prompts). Participants who withdrew from the study prematurely received partial payment based on the amount of the study they completed prior to dropping out. The data of individuals not completing the study was excluded from the final dataset. Additionally, in order to increase the likelihood that the final sample consisted of individuals who took participation seriously, those responding to less than half (15) of the EMA prompts were removed from the final sample (a common practice in EMA studies; e.g., Wenze et al., 2009). See Figure 1 for a summary of study procedure.

Participants

A total of 148 adults responded to the flyers and completed the screening survey, of whom, 142 were eligible for participation and invited to participate in the study. Individuals were considered eligible to participate in the study if they: 1) scored greater than one standard deviation (3.0) above the average score of previous random community samples (9.0; Treynor et al., 2003) on the RRS-B and/or above the suggested cutoff of the B-PSWQ (15.0; Topper et al., 2014); 2) are over the age of 18; 3) are able to read and write English fluently; and 4) have a working smart phone capable of running the EMA survey app. Individuals were deemed ineligible and not considered for participation if they: 1) had significant, uncorrected hearing or vision impairments, if evidenced during consent process, as this would have prevented them from being able to watch the skills training video required for this study; and 2) had cognitive impairments to the extent that they were unable to understand the research consent forms.

After removing non-completers (those who completed the screening survey but ended participation prematurely by not scheduling or showing up for their lab visit or not completing the EMA monitoring period; n=68), low EMA responders (<50% of EMA prompts; n=2), and one outlier, the final sample used for analyses consisted of 71 participants. Of the final sample, 63.4% (n=45) were female, 36.6% (n=26) were male, and none identified as transgendered, non-binary, or other. The racial/ethnic breakdown of participants is as follows: 45.1% (n=32) of participants identified as non-Hispanic white, 36.6% (n=26) as Asian, 8.5% (n=6) as Black/African-American, 7.0% (n=5) as non-white Hispanic/Latinx, and 2.8% (n=2) as multiracial. Participants ranged in age from 18-68 (Median=21, Mean=24.96, SD=10.07), and reported a modal annual household income of over $90,000 (31.0%; n=22) with 19.7% (n=14) reporting $50,000-$69.99, and 16.9% (n=12) reporting less than $10,000. In terms of educational attainment, 14.1% (n=10) reported a high school degree or GED (none reported less than that), 42.3% (n=30) had some taken some college courses, 25.4% (n=18) had received a 4-year college degree, and 18.3% (n=13) had a graduate degree. In terms of treatment experiences, 54% (*n* = 38) had never received either talk therapy or psychotropic medication-based treatment, 23% (*n* = 16) had received both, 24% (*n* = 17) had only received talk therapy, and none had received medication only. Currently (as reported at the time of the pre-lab visit survey), 70% (*n* = 50) were not receiving either talk therapy or medication-based treatment, 14% (*n* = 10) were receiving talk therapy only, 8% (*n* = 6) were receiving medication only, 6% (*n* = 4) were receiving both, and 1% (*n* = 1) declined to answer.

Measures and Materials

Demographics and Treatment History. As part of the pre-lab visit survey, participants were asked to report their: age, gender, race/ethnicity, education level, and household income. They were also asked to report on their current and historical mental health treatment(s), both psychotherapy & psychotropic medication.

Trait Rumination. The Brooding subscale of the Ruminative Response Scale (RRS-B) is a five-item self-report questionnaire assessing dysfunctional rumination (Treynor et al., 2003). Items are rated on a four-point Likert-type scale ranging from 1 (almost never) to 4 (almost always) reflecting what they *generally* do in response to negative mood (or what they had done in the past week for the post-EMA survey). Items are summed to produce a total score ranging from 5-20. Sample items include "think 'why can't I handle things better'" and "think about a recent situation, wishing it had gone better." The RRS-Brooding subscale has demonstrated good internal consistency ($\alpha = .77$) and moderate retest reliability ($r = .62$) as well as convergent and predictive validity in previous studies (Treynor et al., 2003). Participants completed this during the online surveys, prior to their lab visit, and after their EMA monitoring period. The scale demonstrated adequate internal consistency in the present study at baseline ($\alpha = .60$) and follow-up ($\alpha = .73$).

Trait Worry. The Brief Form of the Penn State Worry Questionnaire (B-PSQW) is a five-item self-report questionnaire assessing worry (Topper et al., 2014). Items are rated on a five-point Likert-type scale reflecting the extent to which each statement is typical for them (or what describes them for the past week in the post-EMA survey), ranging from 1 (not at all typical of me) to 5 (very typical of me). Items (e.g., "I know I should not worry about things, but I just cannot help it") are summed to produce a total score ranging from 5-25. The B-PSWQ has demonstrated good internal consistency in previous samples ($\alpha = .91$), correlation with the full PSWQ ($r = .94$), and diagnostic efficiency using a cutoff of 15 (sensitivity = .90 specificity = .89; Topper et al., 2014). Participants completed this during the online surveys, prior to their lab visit, and after their EMA monitoring period. The scale demonstrated good internal consistency in the present study at baseline ($\alpha = .88$) and follow-up ($\alpha = .91$).

Repetitive Negative Thinking. The Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011) is a 15-item self-report questionnaire designed to assess respondents' tendency to engage in RNT when thinking about problems/negative experiences. The PTQ consists of five sets of three questions assessing the core characteristics of RNT as the measure's authors conceive it: 1) repetitive (e.g., "the same thoughts keep going through my head again and again"); 2) intrusive (e.g., "thoughts come to my mind without me wanting them to"); 3) difficult to disengage from (e.g., "I can't stop dwelling on them"); 4) unproductive (e.g., "I keep asking myself questions without finding an answer"); and 5) capturing mental capacity (e.g., "my thoughts prevent me from focusing on other things"). Items are rated on a five-point Likert-type scale ranging from 0 (never) to 4 (almost always) and are summed to create a total score ranging from 0-60. The PTQ has demonstrated good internal consistency ($r = .94$-$.95$) and retest reliability (.69) as well as convergent and predictive validity in previous studies (Ehring et al., 2011). As this study is interested in changes in RNT, the temporal anchoring of the measure's initial prompt ("describe how you typically think about negative experiences or problems") was changed to reflect the prior week ("describe how you have typically thought about negative experiences or problems the past week"). Participants completed this during the online surveys, prior to their lab visit, and after their EMA monitoring period. The scale demonstrated good internal consistency in the present study at baseline (α = .92) and follow-up (α = .85).

Cognitive Emotion Regulation Strategies. The Short Form of the Cognitive Emotion Regulation Questionnaire (CERQ-SF; Garnefski & Kraaij, 2006) is an 18-item self-report questionnaire, which was used to assess the cognitive emotion regulation strategies participants typically use in response to stressful life events. Participants rated how often statements applied to them (in general for the pre-lab survey and in the past week for the post-EMA survey) on a five-point Likert-type scale ranging from 1 (almost never) to 5 (almost always). The CERQ-SF contains nine two-item subscales: 1) self-blame (e.g., "I feel that I am the one who is responsible for what has happened"); 2) acceptance (e.g., "I think that I have to accept that the situation"); 3) focus on thought (e.g., "I often think about how I feel about what I have experienced"); 4) positive refocusing (e.g., "I think of pleasant things that have nothing to do with it"); 5) refocus on planning (e.g., "I think about how to change the situation"); 6) positive reappraisal (e.g., "I think I can learn something from the situation"); 7) putting into perspective (e.g., "I tell myself that there are worse things in life"); 8) catastrophizing (e.g., "I continually think how horrible the situation has been"); and 9) other-blame (e.g., "I feel that basically the cause lies with others"). The CERQ-SF has demonstrated good internal consistency (r = .68-.81) as well as good criterion and convergent validity in previous studies (Garnefski & Kraaij, 2006; Ireland, Clough, & Day, 2017). Participants completed this during the online surveys, prior to their lab visit, and after their EMA monitoring period. The measure's subscales demonstrated adequate internal consistency in the present study at baseline (α range = .57-.87) and follow-up (α range = .72-.88).

Depression, Anxiety, & Stress. The Depression Anxiety Stress Scale-Short Form (DASS-21; Lovibond & Lovibond, 1995) is a 21-item self-report questionnaire assessing participants' levels of depression, anxiety, and stress. The DASS-21 consists of three seven-item subscales: 1) depression (e.g., "I couldn't seem to experience any positive feelings at all"); anxiety (e.g., "I felt scared without any good reason"); and 3) stress (e.g., "I found myself getting agitated"). Each item is rated on a four-point Likert-type scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time); scores are calculated by summing all seven items for each subscale, producing total scores ranging from 0-21 for each subscale as well as a total score (sum of all three subscales) ranging from 0-63. The DASS-21 has demonstrated good internal consistency (r = .87-.94) in both clinical and non-clinical samples (Antony, Bieling, Cox, Enns, & Swinson, 1998; Henry & Crawford, 2005). Participants completed this during the online surveys, prior to their lab visit, and after their EMA monitoring period. The measure's subscales demonstrated good internal consistency in the present study at baseline (α range = .76-.90) and follow-up (α range = .81-90).

Difficulties in Emotion Regulation. The Difficulties in Emotion Regulation Scale Short Form (DERS-SF; Kaufman et al., 2016) is am 18-item self-report questionnaire used to assess respondents' difficulties with emotion regulation. Respondents indicate the extent to which each item applies to them on a five-point Likert-type scale ranging from 1 (almost never) to 5 (almost always). The DERS-SF has six subscales: 1) non-acceptance of emotional responses (e.g., "when I'm upset, I become embarrassed for feeling that way"); 2) difficulties engaging in goal-directed behavior (e.g., "When I'm upset, I have difficulty focusing on other things"); 3) impulse control difficulties (e.g., “When I’m upset, I become out of control”); 4) lack of emotional awareness (e.g., “I care about what I am feeling” [reverse scored]); 5) limited access to emotion regulation strategies (e.g., “When I’m upset, I believe there is nothing I can do to make myself feel better”); and 6) lack of emotional clarity (e.g., “I am confused about how I feel”). The DERS-SF has demonstrated good internal consistency in previous studies (r = .79-.91) though retest reliability has yet to be assessed/established (Kaufman et al., 2016). Participants only completed this during the pre-lab visit survey as it was designed as a trait measure and therefore not intended to be sensitive to change. The measure’s subscales demonstrated good internal consistency in the present study (α range = .63-.91).

Experiential Avoidance. The Acceptance and Action Questionnaire-II (AAQ-II; Bond et al., 2011) is a seven-item self-report questionnaire used to assess participants’ tendency to engage in experiential/psychological avoidance (e.g., “my painful memories prevent me from having a fulfilling life”). Answers are given on a seven-point Likert-type scale ranging from 1 (never true) to 7 (always true); responses to each item are summed to produce a total score ranging from 7-49. The AAQ-II has demonstrated good internal consistency (r = .84) and retest reliability (r = .79) in previous studies (Bond et al., 2011; Wolgast, 2014). Participants will complete this during the online surveys, prior to their lab visit, and after their EMA monitoring period. The scale demonstrated good internal consistency in the present study at baseline (α = .85) and follow-up (α = .85).

Momentary RNT. Participants were asked to rate six items assessing the extent to which they have been engaging in RNT since their last report using a five-point Likert-type scale ranging from 1 (not at all) to 5 (a great deal). Participants rated their overall level of rumination as well as five other items believed to assess the key aspects of RNT drawn from the PTQ items with the highest factor loading to the relevant factor. Items selected were: my thoughts repeat themselves (repetitive); thoughts intrude into my mind (intrusive); I get stuck on certain issues and can't move on (difficult to disengage from); I keep asking myself questions without finding an answer (unproductive); and my thoughts prevent me from focusing on other things (capture mental capacity). Participants completed this during each EMA assessment. Additionally, the same items were used to assess participants' momentary RNT during their in-lab assessment, except the time frame was changed to assess their RNT in "the *present* moment."

Affect. Participants' current levels of positive and negative affect was measured using a pair of Visual Analogue Scales (VASs), which participants used to rate the extent to which they feel each on a scale ranging from 0 (not at all) to 4 (a great deal). In addition to the overall affect (Positive and Negative Affect; PA/NA) each VAS also listed six emotions that make up the affect. Negative Affect listed sad, anxious/scared, guilty/ashamed, angry, overwhelmed, and upset. Positive Affect listed calm/relaxed, interested, happy, proud, strong/confident, and excited. Participants completed this during each EMA assessment and during each of the in-lab assessments.

Skills Use and Acceptability. Participants' use of skills since the time of the last assessment was assessed using three face-valid questions asking about their use and the perceived helpfulness of the skills (taught during the lab visit for the active condition; ambiguous for the control condition). Questions included: "I was able to notice/catch myself when I was ruminating," "I used the skills when I found myself ruminating," and "I found the skills helpful/effective in reducing my rumination when I used them;" and were rated on a five point Likert-type scale ranging from 1 (not at all) to 5 (a great deal). Participants completed this during each EMA assessment.

As part of the post-EMA survey, participants were also asked a series of face valid questions about their opinions and experiences with the skills/intervention (skills taught during the lab visit for the active condition; ambiguous for the control condition). Questions asked included "I liked the intervention," "The intervention and the skills make sense to me," "I understand how to use the skills taught in this intervention," "I think this intervention is a good way to address rumination," "I will continue to use the skills taught in this intervention," "I feel that my rumination improved over the course of the study," "I found the skills helpful when I used them," "I would recommend this intervention to a friend," "I would participate in this study again if I wasn't paid," "Did you have the opportunity to use the skills over the course of the study? If so, how often?" "Did you use the skills you were taught? If so, how often?" and "Did you watch the skills training video after the in-lab viewing? If so, how often?" They were also asked to provide any additional comments/opinions in an open-ended question at the end of the survey. Participants responded to each item by rating the extent to which they agree for statements or choosing a frequency on a seven-point Likert-type scale for the items asking for a numeric response.

Expectancy Questionnaire. Active condition participants' expectations about the skills training intervention and its effects on their rumination over the course of the study were assessed during the final survey during their lab-visit. Participants responded to six questions adapted from the credibility/expectancy questionnaire developed by Devilly & Borkovec (2000) to assess patients' expectations about a PTSD treatment (e.g., "at this point, how successfully do you think this therapy will be in reducing your PTSD symptoms). Questions are rated on either a nine-point Likert-type scale ranging from 1 (not at all) to 9 (very) or by selecting a percentage (0-100%) on a visual analogue scale with 10 anchor points (0%, 10%, 20%, etc.). The overall structure of the questionnaire was retained, however, the wording of the questions was changed to be consistent with the terminology used in the rest of the study (i.e., therapy will be changed to skills training intervention, and anxiety/trauma will be changed to rumination). The questionnaire has demonstrated high internal consistency (r = .84), retest reliability (r = .82), and predictive validity in prior studies (Devilly & Borkovec, 2000).

Rumination Induction. The present study induced ruminative thinking in participants using the rumination induction paradigm developed by Lyubomirsky and Nolen-Hoeksema (1993). Participants were asked to focus their attention and thinking about a series of 45 statements presented on PowerPoint slides. The slides were indented to focus participants' attention on thoughts that are emotion focused, symptom focused, and self-focused. For example, they asked participants to think about "how active/passive you feel," "the kind of person you are," and "why you react the way you do." Participants were given 10 minutes to spend reading and thinking about the slides' prompts, however no instructions are given with a specific amount of time to spend on each slide. Similar procedures have been used in a number of previous studies on rumination and were found to effectively induce ruminative thoughts (e.g., Broderick, 2005; Huffziger, & Kuehner, 2009; Lyubomirsky, Kasri, & Zehm, 2003; Lyubomirsky and Nolen-Hoeksema, 1993).

Skills Training Video. Participants in the active condition of the study watched a 30-minute psychoeducation, skills training, practice, and planning video. The video first defined rumination, and then explained both why people ruminate and why it is generally ineffective in serving its intended function(s). Then, participants were taught two mindfulness-based skills to be used when they notice themselves ruminating. The first, mindfully observing the breath, was taught as a way to respond to rumination when they are not currently engaging in another activity, and the second, one-mindful action, was taught as a way to respond to rumination when they were doing another activity prior to ruminating (see Appendix 2 for video URL).

Analysis Plan

An a priori statistical power analysis was performed for sample size estimation for each of the planned analyses. The analysis requiring the highest number of participants (n=95) to detect a medium effect size with a beta of .15 and an alpha of .05 was a linear regression containing four variables (condition, time, and two control variables) to predict levels of EMA reported RNT. Therefore, the target sample size for the present study was 100.

First, descriptive statistics for all study variables was conducted and then they were assessed for outliers, normality, heteroskedasticity, and independence. Next, bivariate correlation analyses were conducted to explore the relationship between our primary outcome variable (PTQ scores) and other study-measured variables that represent potential confounds (e.g., age, gender, ethnicity). Then, the psychometric properties of the momentary RNT scale used for EMA and in-lab assessments were assessed using an exploratory factor analysis.

In order to test Hypotheses regarding immediate effects of the intervention (1a and 2a), a series of repeated measures ANOVAs were conducted, in which the within-subjects factor of time, the between-subjects factor of condition, and their interaction term were entered as predictor variables, with momentary RNT/NA (assessed during lab visit) as the outcome variables.

In order to test Hypotheses regarding short-term effects of the intervention based on momentary assessments (1b, 2b, and 3b), a series of multilevel regressions was conducted, in which [EMA-reported] momentary RNT/NA/skills use were predicted by the level-1 (within-subject) fixed-effect of time (assessment number), the level-2 (between-subject) fixed-effect of condition (skills training vs control), and their interaction. Given that RNT is conceptually tied to NA (momentary NA is both predicted by and a predictor of momentary RNT; Hughes et al., 2019), for regressions predicting RNT, we also included NA entered as a fixed-effect level-1 (within-subject) predictor (centered around the group mean to facilitate interpretation of results and reduce potential issues with multicollinearity).

In order to test Hypotheses regarding short-term effects of the intervention based on pre-post comparisons of retrospective self-report questionnaires (1c), a repeated measures ANOVA was conducted. The within-subjects factor of time (baseline/follow-up), the between-subjects factor of condition (active/control), and their interaction term were entered as predictor variables, with RNT as the outcome variable. Additionally, exploratory analyses were conducted comparing the effects of time by group regarding symptoms of psychopathology related to RNT (depression, anxiety, general stress, and experiential avoidance) and cognitive coping strategy use (CERQ scores). As we are interested in the functional impact of the intervention, beyond the statistical significance of changes in RNT, we also calculated the clinical significance and reliable change index for each participant and categorized them using the method outlined by Wise (2004). We then compared the distribution of treatment response categorizations between conditions using a Somers' d analysis. Additionally, a post-hoc power analysis was conducted to assess the observed power in the final sample.

Descriptive statistics of the active condition participants' perceived acceptability of the intervention initially (Hypothesis 3a) and after a week of monitoring (Hypotheses 3c and 3d) were calculated. Ratings of 5 or more on both questionnaires were considered indicative of acceptability as they indicated at least some agreement with the statements. Additionally, in order to test Hypotheses 3c and 3d, participants' responses to the acceptability and skills use questionnaires were compared by condition using a series of independent samples t-tests.

III. Results

Recruitment & Retention

A total of 148 individuals responded to recruitment flyers by completing the screening survey; 142 (96%) of those were eligible (six were deemed ineligible due to subthreshold RRS-B *and* B-PSWQ scores). Of the 142 eligible individuals invited to participate in the study, 90 (63%) responded to complete the pre-lab visit survey and schedule their visit (52 either did not respond or declined our invitation to participate). Seventy-six (84%) of the 90 scheduled individuals attended the lab visit and enrolled in the EMA phase of the study (14 did not attend and therefore dropped out of the study at this point). All but two (*n* = 74; 97%) of participants beginning the EMA protocol completed the monitoring week, and 72 of the 74 (97%; 49% of those screened for eligibility) responded to more than 50% of EMA prompts. One outlier was identified and removed from the dataset, leaving a final sample size of 71 (see Figure 2 for a flow chart of recruitment and retention). Lastly, the in-lab data for one participant in the control condition was lost due to research staff error, their data was not included in the analyses of the lab visit data but was retained for baseline-follow-up and EMA data analyses. This final sample size was lower than our target of 100, leaving the study underpowered for some analyses. Recruitment rates were slower than anticipated and we were had to end recruitment for the study prematurely due to financial constraints preventing the extension of our license with LifeData.

Assumption Checks and Descriptive Statistics

Descriptive statistics for all measures and relevant subscales were conducted and are displayed in Table 1. Skew and kurtosis were analyzed and histograms and Q-Q plots were visually inspected; the data did not violate assumptions of normality or independence and no transformations were made to the data. Based on the recommendations by Aguinis, Gottfredson, and Joo (2013), error-based outliers were operationalized as participants with extreme scores (*M* +/- 2.5 *SD*) on multiple measures. One such outlier was identified (extreme scores on three measures), upon visual inspection of the participant's responses it appeared likely that random responding (selecting all maximum ratings for scales) was the cause of the outlying scores; the participant's data was removed from the dataset and not included in analyses.

As expected, given the nature of the sample (general community sample screened for elevated trait rumination/worry), participants' scores on baseline measures were closer to that established norms of clinical populations than unselected community samples. The final sample used for analyses ($n = 71$) was relatively balanced in terms of condition: Active condition ($n = 38$) represented 54% (control $n = 33$; 46%). The two conditions did not differ significantly from each other on any demographic or baseline measures or subscales, with one exception: the active condition scored higher ($M = 11.13$; $SD = 3.57$) on the catastrophizing subscale of the CERQ compared to that of the control condition ($M = 9.36$; $SD = 3.48$) to significant extent ($t(69) = -2.11$, $p = .04$).

Psychometric Properties of Momentary RNT Scale

In order to assess the internal consistency of the momentary RNT measure, a series of exploratory factor analyses (EFAs) was conducted on EMA and lab-visit momentary RNT assessments, which consisted of five items (provided in measures section above). A total of five EFAs were conducted (one for each of the four in-lab surveys and one for the EMA responses). All EFAs produced comparable results with all items loading onto a single factor with eigenvalues ranging from 3.14 to 4.02, explaining 62.85 to 80.40% of the variance, and individual items' factor loadings ranging from .69 to .92. Furthermore, results indicated strong internal consistency with Cronbach's alphas ranging from .85 to .94.

Baseline & Follow-up Survey Data

Correlation Analyses. In order to identify potential confounds to control for in subsequent analyses, we conducted a series of bivariate correlations between our primary outcome variable (RNT) with other study variables. There were no significant relationships between RNT at baseline or follow-up and any demographic variables (age, gender, ethnicity, income, education level, or treatment experiences). While RNT levels at baseline and follow-up were significantly correlated with all other symptom measures (RRS-B, B-PSWQ, AAQ, DERS, DASS, & FFMQ), they were not considered confounds needed to be controlled for in analyses as the constructs conceptually overlap of with each other (e.g., RNT is related to depression, anxiety, and stress; including them together in analyses would introduce potential multicollinearity issues).

ANOVA Analyses. In order to compare the change in RNT over time by treatment condition (Hypothesis 1c), a repeated measures ANOVA was conducted. The within-subjects factor of time (baseline/follow-up), the between-subjects factor of condition (active/control), and their interaction term were entered as predictor variables, with RNT (PTQ scores) as the outcome variable. Additionally, exploratory analyses were conducted comparing the effects of time by group regarding symptoms of psychopathology related to RNT (depression, anxiety, general stress, and experiential avoidance) and cognitive coping strategy use (CERQ scores). Results are summarized in the text below and visually represented in Figures 3.1-3.3.

Regarding RNT, results supported Hypothesis 1c, indicating that there was a significant main effect of time ($F(1, 69) = 38.73$, $\eta_p^2 = .36$, $p < .001$), as well as a time-by-condition interaction ($F(1, 69) = 9.97$, $\eta_p^2 = .13$, $p = .002$). Specifically, while both conditions decreased significantly over time, the active condition demonstrated a significantly greater decrease in RNT levels from baseline (*M* = 40.32, *SD* = 9.15) to follow-up (*M* = 30.16, *SD* = 9.60) compared to that of the control condition (*M* = 37.79, *SD* = 9.87; *M* = 34.47, *SD* = 12.51). Finally, not only were the effects statistically significant, the effect sizes (partial eta squared) were medium for the interaction and large for the main effect of time.

Exploratory analyses revealed a similar pattern of change in terms of participants' experiential avoidance, such that there was a significant main effect of time ($F(1, 69) = 13.92$, $\eta_p^2 = .17$, $p < .001$) and time-by-condition interaction ($F(1, 69) = 7.5$, $\eta_p^2 = .10$, $p = .008$). Specifically, while both conditions decreased significantly over time, the active condition demonstrated a significantly greater decrease in RNT levels from baseline (*M* = 32.58, *SD* = 7.55) to follow-up (*M* = 26.45, *SD* = 7.45) compared to that of the control condition (*M* = 30.42, *SD* = 10.01; *M* = 29.48, *SD* = 11.16). The effect sizes of both main and interaction effects were medium.

Additionally, there was a significant time-by-condition interaction when general stress was used as the outcome ($F(1, 69) = 4.90$, $\eta_p^2 = .07$, $p = .03$). Specifically the active condition demonstrated a significant decrease in general stress levels from baseline (*M* = 9.82, *SD* = 3.88) to follow-up (*M* = 7.71, *SD* = 4.28) while the control condition reported statistically comparable levels at baseline (*M* = 8.67, *SD* = 4.35) and follow-up (*M* = 8.97, *SD* = 4.95). While statistically significant, the effect size is considered small. However, there were no significant main or interaction effects regarding participants' symptoms of depression or anxiety.

Finally, participants' use of certain cognitive coping strategies changed. Specifically, there was a main effect of time on their use of self-blame ($F(1, 69) = 12.83$, $\eta_p^2 = .16$, $p = .001$), acceptance ($F(1, 69) = 4.13$, $\eta_p^2 = .06$, $p = .046$), and refocusing on the positives ($F(1, 69) = 6.30$, $\eta_p^2 = .08$, $p = .01$). Specifically, at follow-up they responded to stress with self-blame ($M_{Time2} = 12.15$, $SD_{T2} = 4.18$; $M_{T1} = 13.54$, $SD_{T1} = 3.33$) and acceptance ($M_{T2} = 12.39$, $SD_{T2} = 3.79$; $M_{T1} = 13.38$, $SD_{T1} = 2.70$) less often and with refocusing on the positives ($M_{T2} = 10.86$, $SD_{T2} = 3.87$; $M_{T1} = 9.80$, $SD_{T1} = 3.59$) more compared that of baseline, however there was no difference in the change based on condition. Additionally, there was a significant main effect of time ($F(1, 69) = 10.82$, $\eta_p^2 = .14$, $p = .002$) as well as time-by-condition interaction ($F(1, 69) = 4.28$, $\eta_p^2 = .06$, $p = .04$) regarding participants' use of [CERQ-assessed] rumination in response to stress. Specifically, while both conditions decreased significantly over time, the active condition demonstrated a significantly greater decrease in rumination from baseline (*M* = 14.50, *SD* = 3.42) to follow-up (*M* = 12.24, *SD* = 3.11) compared to that of the control condition (*M* = 14.48, *SD* = 3.14; *M* = 13.97, *SD* = 3.70). There were no significant main or interaction effects in terms of participants use of refocusing on planning, positive reappraisals, putting in perspective, catastrophizing, or blaming others in response to stress when comparing baseline to follow-up scores.

Post-Hoc Power Analysis. A power analysis was conducted to assess the observed power in the final sample using the effect size (.126), sample size (71), correlation between repeated measures (.57), and structure of the ANOVA model (two between and two within-subjects predictor levels) predicting RNT. Results indicated that the power of the study's primary analysis was .62, and therefore underpowered.

CS/RCI Analyses. In order to facilitate a more meaningful interpretation of participants' change in RNT levels—beyond that of statistical significance or effect size—we assessed the clinical significance and reliability of their changes. Following the methods proposed by Wise (2004), we calculated the RCI of the change for each participant as well as the CS of their changes, and categorized participants based on the combination of their CS and RCI scores. Clinically significant change was assessed based on how much participants' scores moved away from the dysfunctional population and towards the functional population; the CS of participants' change was determined based on the number of standard deviations they decreased. This method of assessing CS was selected based on the fact that the norms of the functional and dysfunctional populations overlap significantly, and therefore alternative CS calculations methods (i.e., using cutoff scores, or calculating whether follow-up scores were more likely to be drawn from the functional that dysfunctional population) could not be utilized. Reliable change was assessed based on how much their change was beyond that expected based on the measurement error. The CS and RCI scores were then combined to categorize participants' changes over the course of the study. Participants were categorized as: "recovered" if they had an RCI greater than 1.96 and a decrease (in the direction of functionality) of two or more SDs; "remitted" if they had an RCI between1.28 and 1.96

and a change of two SDs; “positive response” if they had an RCI above 1.28 and a change of one SDs; “minimal positive response” if they had an RCI greater than 0.84 and a change of 0.5 SDs; “minimal negative response” if they had an RCI less than –0.84 and a change of –0.5 SDs; “negative response” if they had an RCI less than -1.28 and a change of 1-2 SDs; and “deteriorated” if they had an RCI less than –1.96 and a change of –2 SDs.

We compared the categorization of participants between the two conditions using Somers’ d, the nonparametric measure of association used with ordinal variables with direction (when there is an independent [condition] and dependent [change classification] variable). Results indicated that there was a significant difference in participants’ change classification based on condition assignment (Somers’ d = .293, p = .018), to the extent that including condition would improve the accuracy of predictions of classification by 29.30%. As can be seen in Table 3, participants in the active condition exhibited change scores that were more likely to be in more favorable (more clinically significant and reliable change). Of note, eight participants in the active condition were categorized as recovered (best possible change classification), compared to only one in the control condition.

Lab Visit Data

During their lab visit, all participants completed a questionnaire assessing their current PA, NA, and RNT at three time points: upon arrival to lab (T1), after the rumination induction (T2), and after the post-induction wait period (T3). Participants in the active condition completed the questionnaire one additional time: following their viewing of the skills training video (T1.5). In order to account for this procedural difference between groups, we conducted two sets of ANOVAs. The first set compared the questionnaires completed upon arrival (T1), after the rumination induction (T2), and after the post-induction wait period for analyses (T3), while excluding the post skills training questionnaire (T1.5), as that time period was unique to the active condition. The second set used the questionnaires completed prior to the rumination induction (T1.5 for the active condition and T1 for the controls) as the baseline scores, comparing those "baseline" assessments (Controls' T1 & Actives' 1.5) to the assessments conducted after the rumination induction (T2), and after the post-induction wait period (T3). For both sets of ANOVAs the within-subjects factor of time, the between-subjects factor of condition, and their interaction term were entered as predictor variables, with momentary RNT/NA/PA as the outcome variables.

Descriptive Statistics. The Means and Standard Deviations of participants' momentary levels of RNT, NA, and PA are fully reported in Table 4 and summarized below separated by condition, with repeated measures t-tests were used to assess the significance of the changes from one time point to the next.

Participants in the control condition (n=32) reported statistically comparable levels of RNT before (T1) and after (T2) the rumination induction ($t(31) = 0.59$, $p = .56$), which decreased significantly from post-induction (T2) to after the wait period (T3; $t(31) = 2.93$, $p = .006$). With regards to NA and PA changes within the control condition, there were no significant changes from pre to post induction ($t(31)_{NA} = -0.64$, $p = .53$; $t(31)_{PA} = 1.39$, $p = .17$) or from post induction to post wait period ($t(31)_{NA} = 1.15$, $p = .26$; $t(31)_{PA} = 0.33$, $p = .75$).

RNT levels of participants in the active condition (n=38) decreased significantly from the time they arrived (T1) compared to after watching the skills training video (T1.5; $t(37) = 7.14$, $p < .001$), did not differ from pre (T1.5) to post rumination induction (T2; $t(37) = .05$, $p = .96$)[1], and decreased significantly from post rumination induction (T2) to post wait period (T3; $t(37) = 3.53$, $p = .001$). The difference from arrival to post rumination induction was also statistically significant ($t(37) = 6.21$, $p < .001$), though the significance was driven by the change from T1 to T2. Analyses of NA yielded a similar pattern of results, with a significant decrease from T1 to T1.5 ($t(37) = 5.85$, $p < .001$), non-significant change from T1.5 to T2 ($t(37) = -1.78$, $p < .083$), and significant decrease from T2 to T3 ($t(37) = 3.71$, $p = .001$). Active condition participants' PA increased significantly from T1 to T1.5 ($t(37) = -4.71$, $p < .001$), decreased from T1.5 to T2 ($t(37) = 2.75$, $p = .009$), and increased again from T2 to T3 ($t(37) = -2.83$, $p = .007$).

ANOVA Analyses. To compare the changes over time between the two conditions (Hypotheses 1a & 2a), the aforementioned two sets of ANOVAs were conducted, and their results are described below and presented graphically in Figure 4. The first set of ANOVAs (comparing T1, T2, & T3 scores) indicated that there were significant main effects for time ($F(1, 68) = 10.79$, $\eta_p^2 = .14$, $p < .001$) and condition ($F(1, 68) = 6.73$, $\eta_p^2 = .09$, $p = .012$) but no significant interaction effect ($F(1, 68) = 0.08$, $\eta_p^2 = .001$, $p = .93$) on participants' levels of RNT (hypothesis 3). Regarding their levels of NA (Hypothesis 4a), results indicated the only significant effect was that of time ($F(1, 68) = 13.68$, $\eta_p^2 = .17$, $p < .001$), not condition ($F(1, 68) = 3.69$, $\eta_p^2 = .05$, $p = .059$) or

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[1] We conducted exploratory analyses to determine if any variable measured as part of this study may be confounding the pre-post RNT induction changes. However, there were no significant correlations between pre-post induction changes and any other study variables.

their interaction (F(1, 68) = 1.25, η_p^2 = .02, p = .29). Results regarding PA, similarly, indicated a main effect for time (F(1, 68) = 5.15, η_p^2 = .07, p = .007) and not condition (F(1, 68) = 2.63, η_p^2 = .04, p = .11) or their interaction (F(1, 68) = 1.76, η_p^2 = .03, p = .18).

The second set of ANOVAs (comparing baseline [T1/1.5], T2, & T3 scores) produced a different pattern of results. Regarding RNT (Hypothesis 3), results indicated a significant main effect of time (F(1, 68) = 41.18, η_p^2 = .38, p < .001) as well as a significant time by condition interaction (F(1, 68) = 16.82, η_p^2 = .20, p < .001), but not a main effect for condition (F(1, 68) = 1.10, η_p^2 = .02, p = .30). Regarding NA (Hypothesis 4a), results indicated a significant main effect of time (F(1, 68) = 12.93, η_p^2 = .16, p < .001) as well as a significant time by condition interaction(F(1, 68) = 12.40, η_p^2 = .15, p < .001), but not a main effect for condition (F(1, 68) = 0.09, η_p^2 < .01, p = .77). Finally, when assessing differences in PA, there was no main effect of time F(1, 68) = 1.15, η_p^2 < .02, p = .32) or condition F(1, 68) = 0.38, η_p^2 < .01, p = .54), however, there was a significant time-by-condition interaction (F(1, 68) = 7.01, η_p^2 = .09, p = .001).

EMA Data

Descriptive Statistics. Participants received six EMA prompts per day for five days, receiving a total of 30 prompts during the EMA monitoring period of this study. As described in the recruitment and retention section above, two participants completed less than 50% (15) prompted assessments and were removed. On average, participants in the final sample used for analyses (n=71) completed 88.07% (M = 26.42, SD = 3.25) of prompted EMAs, representing excellent response rates. Furthermore, 10% (n=7) completing all 30, 18% (n=13) completing 29, 20% (n=14) completing 28, and 76%

(n=54) completing 25 or more of the 30 prompted EMAs. Across the 71 participants, a total of 2,129 assessments were prompted and 1,887 (88.63%) were responded to and completed. Each EMA prompted participants to respond initially and then gave a reminder 15, 30, & 45 minutes later; on average, participants required 0.70 (*SD* = 1.08) reminders before completing the assessment. The duration of EMA sessions was relatively short on average (*M* = 1min 15s) with a relatively wide range (*SD* = 7min 20s).

Multilevel Regression Analyses. In order to test Hypotheses 1b, 2b, and 3b, a series of multilevel regressions was conducted, in which momentary RNT/NA/skills use were predicted by the level-1 (within-subject) fixed-effect of time (assessment number), the level-2 (between-subject) fixed-effect of condition (skills training vs control), and their interaction. Given that RNT is conceptually tied to NA (NA is both predicted by and a predictor of RNT; Hughes et al., 2019), for regressions predicting RNT, we also included NA entered as a fixed-effect level-1 (within-subject) predictor (centered around the group mean to facilitate interpretation of results and reduce potential issues with multicollinearity). Supporting this relationship, correlational analyses of the EMA data yielded a significant correlation between momentary RNT and NA ($r = .68$, $p < .001$). Results from the regression models are described in text below and to facilitate interpretation, the model-adjusted predicted values of the outcome variables were plotted against time (EMA prompt number) in figures 4.1 through 4.5.

When predicting participants momentary RNT, results indicated a significant main effect of NA ($\beta = 2.52$, SE$\beta = .08$, $t(1, 1606.57) = 32.53$, $p < .001$) and time ($\beta = -0.02$, SE$\beta = .01$, $t(1, 914.02) = -2.07$, $p = .038$) as well as a time-by-condition interaction ($\beta = 0.03$, SE$\beta = .02$, $t(1, 926.77) = 2.27$, $p = .024$), such that the between-condition difference increased over time (See Figure 4.1). The main effect of NA indicates that higher levels of NA predicted higher levels of RNT. The significant positive interaction indicates that, when controlling for NA levels, the effect of study condition on RNT increased as time went on. Specifically, while both groups reported comparable levels of RNT at the beginning of the EMA monitoring period, by the end of the monitoring period, the control condition reported significantly more RNT than that of the active condition.[2]

The results from the model predicting momentary NA indicated a significant main effect of time (β = 0.01, SEβ = .003, $t(1, 859.82) = 4.14$, $p < .001$) as well as a time-by-condition interaction (β = -0.02, SEβ = .01, $t(1, 867.55) = -3.46$, $p = .001$), but no main effect for condition. The negative Beta for the interaction term indicates that the effect of time on momentary NA was less for the active condition than the control condition, meaning that while momentary NA levels were relatively consistent for the active condition, they increased significantly over time for the control condition.

Participants' reported ability to catch themselves when they were engaging in RNT was significantly predicted by NA (β = 0.27, SEβ = .02, $t(1, 1641.75) = 11.52$, $p < .001$), time (β = -0.02, SEβ = .003, $t(1, 945.31) = -5.10$, $p < .001$), and a time-by-condition interaction (β = 0.02, SEβ = .01, $t(1, 959.93) = 3.31$, $p = .001$). Meaning that, while participants in both conditions caught themselves engaging in RNT less often over time, the conditions diverged as time went on as well. So, while the conditions were not significantly different at the start of the EMA monitoring period, as time went on the

[2] To further assess the inclusion of NA in the model, we compared the Information Criteria, an indicator of model fit where lower values indicate better fit, of the model with and without NA included. Supporting the inclusion of NA, the information criteria, both Akaike Corrected (AIC) and Bayesian (BIC), was lower when NA was included (AIC = 9,621; BIC = 9,791) than when it was not (AIC = 10,456; BIC = 10,636).

active condition reported significantly higher rates of catching themselves when engaging in RNT compared to the control condition.

Participants reported use of skills when they noticed they were engaging in RNT was significantly predicted by NA (β = 0.07, SEβ = .02, t(1, 1554.86) = 3.22, p = .001), condition (β = 0.57, SEβ = .22, t(1, 90.37) = 2.63, p = .01), time (β = -0.01, SEβ = .003, t(1, 953.94) = -2.22, p = .027), and a time-by-condition interaction (β = 0.01, SEβ = .01, t(1, 958.36) = 2.53, p = .012). Results indicated that participants in the active condition reported greater rates of skills use, reported skills use increased as NA went up, and reported rates of skills use decreased over time. The interaction effect suggested that as time went on, the two groups diverged such that the control condition reported decreased skills use while the active condition reported an increase.

Participants reported success in using skills to reduce RNT was significantly predicted by condition (β = 0.71, SEβ = .23, t(1, 86.59) = 3.10, p = .003), time (β = -0.01, SEβ = .003, t(1, 962.19) = -2.73, p = .006), and a time-by-condition interaction (β = 0.01, SEβ = .004, t(1, 975.22) = 2.24, p = .025), with a pattern of results comparable to that reported for the model predicting skills use (except no effect of NA).

Intervention Perception Data

Expectations. Based on their responses to the expectancy questionnaire, participants in the active condition were relatively confident of the intervention overall (see Table 4 for full question list and results), indicating that it seemed logical (M = 7.66, SD = 1.19, 100% **≥ 5**), anticipating it successfully helping reduce RNT (M = 6.58, SD = 1.54, 94.74% **≥ 5**), and that they would recommend it to a friend struggling with RNT (M = 7.18, SD = 1.89, 86.84% **≥ 5**).

Acceptability. The two conditions' responses to the acceptability questionnaire were compared using a series of independent samples t-tests. The active condition rated all acceptability questions significantly higher than the control group, with the exception of one: "I would participate in this study again even if I wasn't paid" which was not significantly different between conditions (see Tables 5 & 6 for full question list and test statistics).

We assessed the active condition's ratings of acceptability questions similarly to that of the expectancy questionnaire analyses, with ratings of five or more reflecting acceptability. Full question list and results are reported in Table 5; in general questions were rated as acceptable by 75% or more of participants, with the only exception being that they would participate in the study again if they weren't paid (only 55.26% agreed with that statement). Additionally, participants in the active condition answered three questions assessing their use of skills during the study. Responses indicated that participants in the active condition had the chance to use and actually used the skills taught in the intervention one or more times per day on average.

IV. Discussion

Repetitive Negative Thinking is a thought process defined as frequent, passive, relatively uncontrollable, and focused predominantly on negative content (Ehring & Watkins, 2008). RNT represents a transdiagnostic process involved in the development and maintenance of a wide variety of psychological disorders and problematic behaviors (Ehring & Watkins, 2008; Harvey, Watkins, Manse, & Shafran, 2004), which has also been identified as a common target in various treatments with demonstrated efficacy (Topper et al., 2010). As such, RNT is emerging as a promising target for transdiagnostic interventions. While a few briefer interventions have demonstrated preliminary efficacy in reducing RNT (Cavanagh et al., 2018; Ruiz et al., 2018), the majority of empirically supported RNT interventions are part of much larger, more complex treatment packages (e.g., MCT, Wells & Papageorgiou, 2004; & RFCBT, Watkins, 2016), and therefore are limited in their ability to reach large portions of the population. Single-session interventions, particularly those capable of being delivered electronically, represent a promising new approach to psychological intervention design with the potential to overcome several barriers to accessing care faced in the context of traditional psychotherapies (Schleider & Weisz, 2017).

Thus, the primary aim of this study was to develop a brief, single-session intervention intended to reduce RNT, and pilot test its preliminary acceptability and efficacy. We set out to design a study that would assess the intervention in a several ways. Participants were recruited from the general community through flyers and online advertisements, screened for high trait RNT, administered baseline assessments, and invited into the lab for the first phase of the study. Participants were then assigned to either an active condition, in which they watched a video teaching them skills to reduce their levels of RNT, or the control condition, where they were not given any specific skills training. The intervention's preliminary efficacy was then assessed by comparing the levels of RNT and NA: following an RNT induction during their lab visit, via frequent momentary assessments for the five days following the lab visit, and by differences in questionnaires administered before the lab visit and after the EMA monitoring period. The intervention's acceptability was assessed based on: their expectations at the end of the lab visit, their momentary reports of skills use and perceived effectiveness, and their retrospective satisfaction and perceived utility of the intervention at follow-up.

The hypotheses that the active condition participants would report less RNT and NA following RNT induction (Hypotheses 1a and 2a) were not able to be assessed in the manner intended due to the unanticipated pattern of responses provided by participants during the lab visit. Specifically, participants in the active condition reported significant decreases in RNT and NA after watching the skills training video, which led to different baseline levels of RNT and NA between the two conditions. Furthermore—and more problematically—neither condition reported significantly increased levels of RNT or NA following the RNT induction and both conditions' RNT and NA significantly decreased during the post-induction wait period. Since the RNT induction did not have its intended effect (increasing RNT levels), comparisons of changes in RNT or NA levels between groups would not speak to the efficacy of the skills training as intended—they didn't have the opportunity to practice the skills learned to reduce induced RNT since RNT was not effectively induced. Furthermore, exploratory analyses attempting to identify potential confounds or moderators of pre-post induction changes failed to identify any such relationships. Given that this induction has not only been successfully used in several studies across various populations (e.g., Lyubomirsky and Nolen-Hoeksema, 1993), but also that this modified version, using PowerPoint slides, has also demonstrated effectiveness (e.g., Broderick, 2005; Huffziger, & Kuehner, 2009; Lyubomirsky, Kasri, & Zehm, 2003), it is surprising that the induction did not lead to an increase in RNT in either condition of the present study. The specific protocol for the present study had the study personnel orient participants to the PowerPoint presentation, with the instructions on the first slide and the prompts on the subsequent slides, and then leaving the room while participants moved through the slides on their own for 10 minutes. It is possible that not having the instructions explained to them by a person left participants unclear on the instructions. Or perhaps leaving participants alone in the room failed to adequately incentivize adherence to task instructions. It is also possible that 10 minutes was insufficient time to allow the induction to have an effect. Future research is needed to better understand the factors that interfered with the induction's effectiveness in studies with designs like that of the present one.

Hypotheses that active condition participants would report less RNT and NA and more skills use (1b, 2b, and 3b) were supported based on the results of the EMA data analyses. Specifically, there were significant time-by-condition interactions in the prediction of monetary RNT and NA, as well as their ability to notice RNT, reported use of skills to respond to RNT, and perceived success of their skills use. There was a main effect for time in all three models predicting skills (noticing, implementing skills, and successfully reducing RNT), such that, overall, participants increased skills use over the course of the week. This increase over time could be a result of self-monitoring, which is a biproduct of EMAs (asking them about RNT several times per day for a week could have contributed to an increased awareness, desire to prevent, and ability to reduce their RNT). There were also significant main effects of group regarding participants' use of and success with skills, such that the active condition reported significantly higher rates, which is as expected since they were taught specific skills while the control condition was not. The time-by-condition interactions were positive for RNT and skills-related models, indicating that over time the difference between conditions increased. This pattern could reflect the active condition developing mastery of the skills taught as they continued to practice them over the week, which would make sense because they were taught an actual skill while the control condition was only learning through self-monitoring. The interaction term for the model predicting momentary NA, however, was negative, indicating that while the active condition reported relatively consistent NA throughout the week, the control condition reported increased levels of NA over the course of the week. This pattern of results makes sense when taken together with other EMA results: as the participants in the control condition were using skills less and engaging in RNT more than the active condition as time went on, the control condition also reported more NA (an established byproduct of RNT; Nolen-Hoeksema et al., 2008) over the course of the EMA monitoring period.

Our hypothesis that participants in the active condition would report greater reductions in RNT over the course of the study (1c) was assessed and supported in terms of both statistical and clinical significance. First, participants in the active condition exhibited a statistically significantly greater decrease in RNT levels over the course of the study compared to the control condition, with a medium-sized effect. Also noteworthy is the fact that there was a significant main effect of time with a large effect size, indicating that the control condition also decreased significantly in their levels of RNT over the course of the study. This could be due to the effect of self-monitoring (which both conditions did by responding to the EMA prompts) or simply a result of regression to the mean (since the sample consisted of individuals screened for elevated rumination/worry). Our exploratory analyses also served to corroborate this pattern of results as established correlates of RNT (experiential avoidance, general stress, and the use of rumination as a cooping strategy; Nolen-Hoeksema et al., 2008; Ruiz et al., 2018; Topper, et al., 2017; Watkins, 2008) also decreased at a greater rate in the active condition compared to that of the control condition, with small-to-medium-sized effects. The non-significant results regarding change in anxiety and depression and use of other cognitive coping strategies may reflect the fact that changing RNT may not immediately translate into reductions in psychopathology (i.e., depression and anxiety). However, the study was underpowered for the ANOVA analyses, so the non-significant results also may have simply reflected an inability to detect existing differences in depression and anxiety. Further supporting Hypothesis 1c is the results of the clinically significant and reliable change analyses, which were significantly more favorable in the active condition compared to the control condition (i.e., a greater portion of individuals were classified as recovered and having a positive response to the intervention). In sum, not only were the differences between groups not likely due to random chance (indicated by statistical significance), they were also reliable and reflect a level of change in RNT that was likely noticeable in participants' daily lives (indicated by RCI & CS analyses).

We hypothesized that participants in the active condition would find the intervention acceptable (3a & 3c); our results supported this, indicating that the intervention was perceived optimistically when it was first learned, and was continued to be viewed favorably after a week of practice using the skill. Participants in the active condition rated their expectations for the intervention relatively favorably at the end of their lab visit. Participants in the active condition also rated the intervention significantly more acceptable on the follow-up assessment: reporting that they liked the intervention, it made sense to them, they understood the skills, they thought the skills were a good way to address rumination, they found the skills helpful when they used them, they felt that their rumination decreased during the study, they would continue to use the skills after the study, and they would recommend the intervention to a friend. The hypothesized greater acceptability of the intervention by the active condition was also supported by their responses on the follow-up assessment (hypothesis 3d), as participants in the active condition reported having frequent (once or more per day) *opportunities* to use as well as *actual use* of the skills than the control condition. The acceptability of an intervention is important not just for the likelihood that it will be used by consumers, but also because individuals who use and find the intervention acceptable are also more likely to continue to engage with treatment and adhere to recommendations of their treatment providers (Schleider & Weisz, 2017).

While, as a whole the results of this study reflect favorably on the intervention, there are a number of limitations that warrant consideration. First, even though the skills training was assessed over a variety of time-points, its long-term effects remain unclear as there were no follow-up assessments beyond a week after the skills training. Given the pervasive nature of RNT and related problems, the clinical utility of the intervention cannot be fully understood without longer follow-up assessments. Second, and relatedly, the present study did not test different doses of the intervention (e.g., viewing in lab only vs each morning for 5 days), and few participants (n = 12) reported viewing the skills training video again after their initial viewing in the lab. Therefore, it is not possible to determine whether an increased dose of the intervention (e.g., additional viewings, skills practices, or reminders about the skills taught) would increase the impact of the intervention—an important question for subsequent research. Third, while we attempted to recruit a representative sample form the general community, our sample consisted of a large proportion of students and was skewed towards younger participants. Further compounding this issue is the fact that student status was not directly assessed as part of the study and as such cannot be statistically controlled for. Therefore, the sample may not actually reflect the general population and the generalizability of the present study's results are limited. Fourth, because the control condition did not receive any skills training, it is impossible to say if the improvements seen in the active condition would be seen where they compared to treatment as usual. Fifth, the fact that the RNT induction did not have its expected effect is concerning. The induction is a well-established method of prompting rumination, so its lack of effect in the present study is concerning. Finally, the final sample size was smaller than intended due to slower than anticipated enrollment and limited funding constraining the duration of study recruitment. The smaller sample size left some of the planned analyses (e.g., the between-subjects regression effects) underpowered and thereby increased the chance of false-negative, leaving genuine effects undetected.

Given the limitations, future studies would benefit from replication using a larger and more diverse sample to increase generalizability as well as power. Additionally, a longer-term follow-up would elucidate the duration of the intervention's efficacy. Incorporating varied doses of the intervention in future study designs would also allow researchers to determine the ideal dose for the intervention. Future studies would also benefit from comparing the intervention to an active control group and/or other established interventions/treatments—helping to answer not just "is this better than nothing?" but more importantly "is this better than what's already available?" Relatedly, this intervention should be assessed as an adjunct to established treatments to help determine its potential fit within the existing mental healthcare framework. Future research would also benefit from assessing the impact of this intervention for individuals placed on a waitlist for treatment, to serve as a boost to give them a skill to practice while they wait for space to open up for them in a more comprehensive treatment program. Furthermore, future investigations that allow for an assessment of the intervention after effectively induced RNT would clarify the immediate-term impact of the skills training. Additionally, future studies should assess the acceptability of the intervention by providers in addition to consumers (participants). Finally, if reductions in RNT are replicated, the next step will be to assess whether these reductions in RNT lead to reductions in symptoms of psychopathology and/or functional impairment in both clinical and non-clinical samples.

Despite these limitations, the present study also has several strengths. First, as far as we know, the active condition intervention represents the shortest (a single 30-min skills training video) intervention for RNT assessed naturalistically. Second, the high expectations and retrospective acceptability reported by the active condition, coupled with relatively low dropout rates, speaks to the acceptability of the intervention. Third, in addition to the acceptability, and despite the limitations outlined above, the intervention demonstrated promising preliminary efficacy with significant reductions in RNT and NA across multiple methods of assessment. Together with the acceptability and preliminary efficacy of the intervention, its brevity, low cost, low time-demand, ability to be delivered online, and applicability to a wide range of populations, make this a promising intervention that warrants continued investigation, development, and refinement.

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Table 1.

Means and Standard Deviations for Study Variables

Measure	**Baseline Descriptive Statistics (n=71)**			**Follow-up Descriptive Statistics (n=71)**		
	Range	Mean	SD	Range	Mean	SD
PTQ	19-59	39.14	9.51	4-55	32.17	11.18
RRS-B	9-20	15.00	2.44	5-20	12.52	3.29
B-PSWQ	8-25	20.11	3.90	5-25	18.04	5.33
CERQ Self-blame	8-20	13.54	3.33	4-20	12.15	4.18
CERQ Acceptance	6-19	13.38	2.70	4-20	12.39	3.79
CERQ Rumination	8-20	14.49	3.27	4-20	13.04	3.48
CERQ Refocus on Positives	4-18	9.80	3.59	4-20	10.86	3.87
CERQ Refocus on Plan	5-20	12.79	3.81	4-20	12.69	3.77
CERQ Positive Reappraisal	4-20	12.72	4.10	4-20	13.27	4.16
CERQ Put in Perspective	5-20	12.75	3.82	4-20	12.83	3.85
CERQ Catastrophizing	4-20	10.31	3.61	4-17	9.46	3.46
CERQ Blame Others	4-18	9.31	3.47	4-20	8.68	3.56
AAQ	11-49	31.58	8.78	9-46	27.86	9.41
DASS-21 Depression	0-21	8.18	5.44	0-19	7.03	5.57
DASS-21 Anxiety	0-18	6.55	4.19	0-17	5.76	4.30
DASS-21 Stress	1-18	9.28	4.11	0-20	8.30	4.61
DERS Strategies	3-15	8.62	3.03	-	-	-
DERS Non-Acceptance	3-15	9.18	2.99	-	-	-
DERS Impulse	3-14	6.37	2.94	-	-	-
DERS Goals	3-15	10.42	3.32	-	-	-
DERS Awareness	3-13	6.37	2.29	-	-	-
DERS Clarity	3-15	7.86	2.74	-	-	-
DERS Total	25-77	48.82	10.60	-	-	-
FFMQ Observe	12-39	26.40	5.59	-	-	-
FFMQ Describe	13-40	25.65	5.97	-	-	-
FFMQ Act with Awareness	12-40	22.39	5.54	-	-	-
FFMQ Non-Judgmentally	8-38	22.38	6.15	-	-	-
FFMQ Non-Reactive	11-37	22.18	5.30	-	-	-

Table 2

Clinically Significant and Reliable Change Classifications by Condition

Condition	Change Classification						
	Negative Response	Minimal Negative Response	Unclassified	Minimal Positive Response	Positive Response	Recovered	Total
Control	2	2	13	8	7	1	33
Active	0	1	13	6	10	8	38
Total	2	3	26	14	17	9	71

Table 3

Means and Standard Deviations of Lab Visit Momentary Assessments

Assessment Timing	Condition	RNT		NA		PA	
		M	SD	M	SD	M	SD
Arrival (T1)	Control	15.47	4.67	2.81	0.97	3.44	1.08
	Active	17.58	3.82	3.45	0.8	3.13	0.66
	Total	16.61	4.33	3.16	0.93	3.27	0.88
Pre-Induction (Active = T1.5, Control = T1)	Control	15.47⁺	4.67⁺	2.81⁺	0.97⁺	3.44⁺	1.08⁺
	Active	12.55	3.92	2.47	0.8	3.71	0.77
	Total	13.89	4.49	2.63	0.89	3.59	0.92
Post-Induction (T2)	Control	15.13	5.62	2.94	1.19	3.19	0.97
	Active	12.53	4.51	2.71	0.9	3.32	0.81
	Total	13.71	5.17	2.81	1.04	3.26	0.88
Post-Wait Period (T3)	Control	13.63	5.81	2.78	1.18	3.16	0.95
	Active	10.92	4.46	2.21	0.84	3.66	0.91
	Total	12.16	5.26	2.47	1.05	3.43	0.96

⁺ = Second Listing of T1 Assessment for Control Condition

Table 4

Expectancy Questionnaire Descriptive Statistics

Expectancy Question	Mean	SD	Range	Median	Mode	N (%) ≥ 5
At this point, how logical does the intervention offered to you seem?	7.66	1.19	5-9	8.00	7	38 (100)
At this point, how successfully do you think this intervention will be in reducing your rumination?	6.58	1.54	3-9	7.00	5	36 (94.74)
How confident would you be in recommending this intervention to a friend who experiences similar difficulties?	7.18	1.89	3-9	8.00	8 & 9	33 (86.84)
By the end of the study period, how much improvement in your rumination do you think will occur?	57.50	18.74	20-100	60.00	50	30 (78.95)
At this point, how much do you really feel that the intervention will help you to reduce your rumination?	6.21	1.86	1-9	6.00	6	31 (81.58)
By the end of the study period, how much improvement in your rumination do you really feel will occur?	49.24	22.77	0-100	50.00	40 & 50	21 (55.26)

Table 5

Acceptability Questionnaire Active Condition Descriptive Statistics (n = 38)

Acceptability Question	Mean	SD	Range	Median	Mode	N (%) ≥ 5
I liked the intervention	5.61	1.15	3-7	6	6	36 (78.90)
The intervention and the skills make sense to me	6.00	0.99	3-7	6	7	36 (78.90)
I understand how to use the skills taught in this intervention	6.03	1.00	3-7	6	7	36 (78.90)
I think this intervention is a good way to address rumination	5.58	1.37	2-7	6	7	32 (84.21)
I will continue to use the skills taught in this intervention	5.63	1.40	1-7	6	7	32 (84.21)
I feel that my rumination improved over the course of the study	5.39	1.39	2-7	5	5	32 (84.21)
I found the skills helpful when I used them	5.50	1.33	2-7	6	5	34 (89.47)
I would recommend this intervention to a friend	5.50	1.41	2-7	6	6 & 7	29 (76.32)
I would participate in this study again if I wasn't paid	4.32	2.13	1-7	5	6	21 (55.26)
Did you have the opportunity to use the skills over the course of the study? If so, how often?	3.89	1.06	1-5	4	4 & 5	n/a
Did you actually use the skills over the course of the study? If so, how often?	3.32	1.04	1-5	3	4	n/a
Did you watch the skills training video after the in-lab viewing? If so, how often?	1.47	0.89	1-5	1	1	n/a

Table 6

Acceptability Questionnaire Compared by Condition

Acceptability Question	Condition	Mean	SD	*t*	Cohen's *d*
I liked the intervention	Control	4.52	1.12	-4.03***	0.96
	Active	5.61	1.15		
The intervention and the skills make sense to me	Control	4.27	1.49	-5.84***	1.37
	Active	6.00	0.99		
I understand how to use the skills taught in this intervention	Control	3.91	1.63	-6.66***	1.57
	Active	6.03	1.00		
I think this intervention is a good way to address rumination	Control	4.30	1.43	-3.84***	0.91
	Active	5.58	1.37		
I will continue to use the skills taught in this intervention	Control	4.03	1.31	-4.95***	1.18
	Active	5.63	1.40		
I feel that my rumination improved over the course of the study	Control	4.00	1.54	-4.02***	0.95
	Active	5.39	1.39		
I found the skills helpful when I used them	Control	3.91	1.47	-4.79***	1.13
	Active	5.50	1.33		
I would recommend this intervention to a friend	Control	4.67	1.51	-2.40*	0.57
	Active	5.50	1.41		
I would participate in this study again if I wasn't paid	Control	3.70	1.85	-1.30	0.31
	Active	4.32	2.13		

*=p<.05, **=p<.01, ***=p<.001

Figure 1.

Summary Diagram of Study Procedure

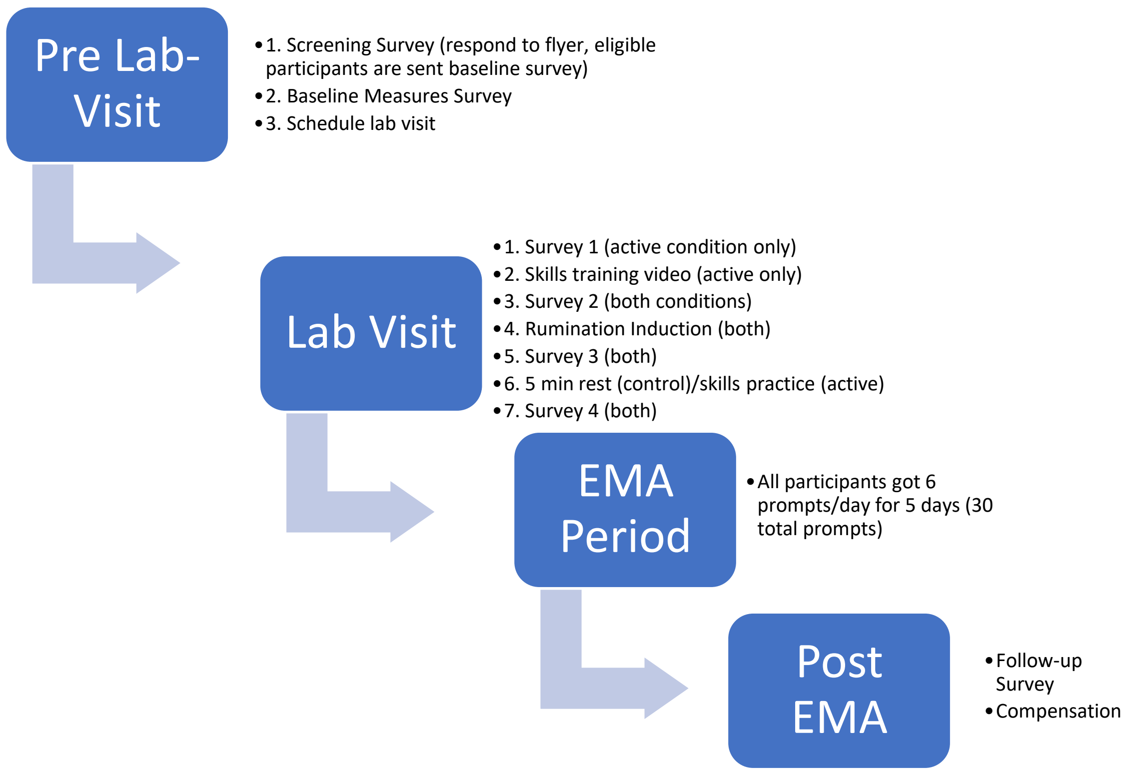


Figure 2

CONSORT Participant Flow Diagram

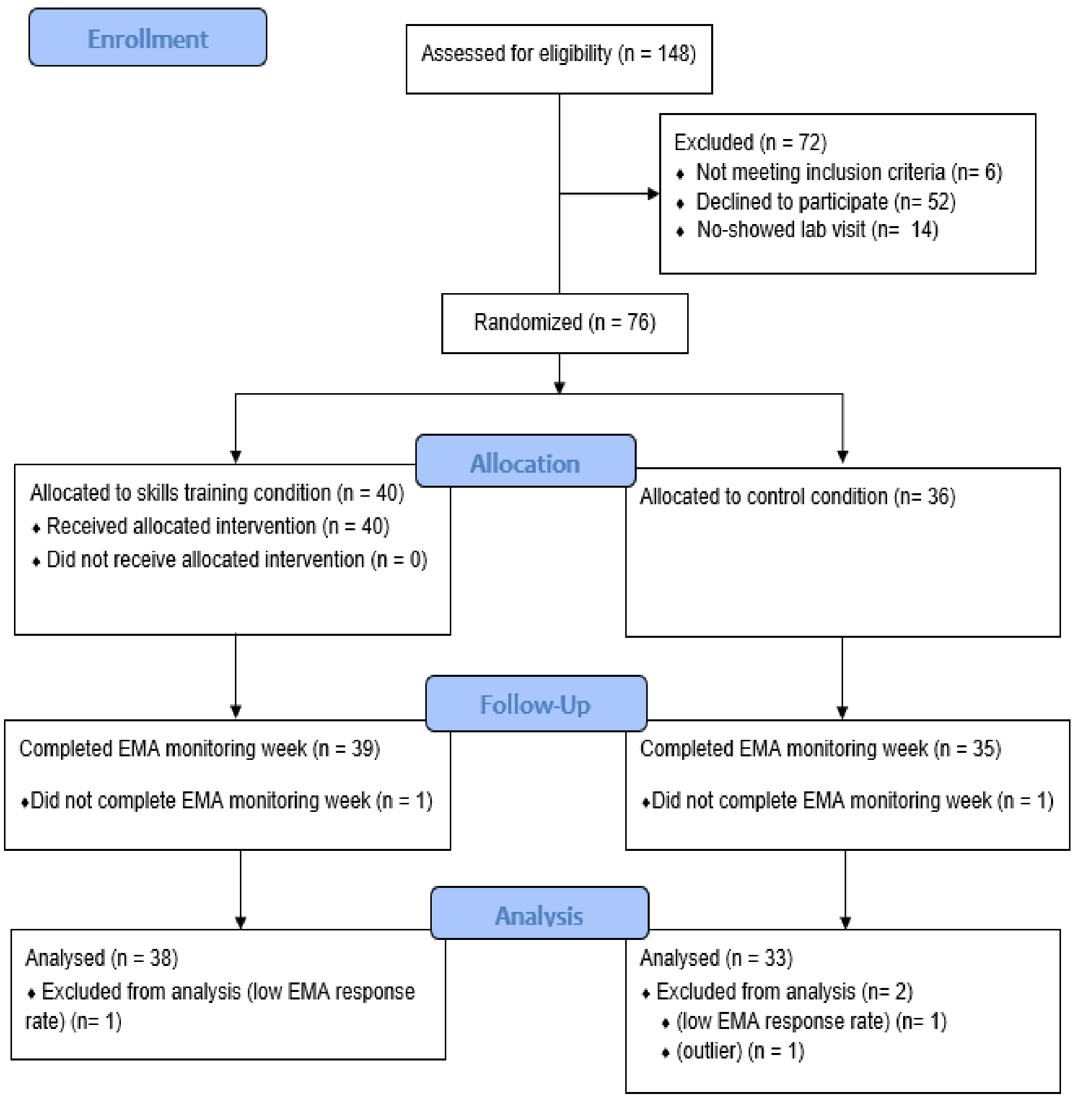


Figure 3.1

Estimated Marginal Means of PTQ

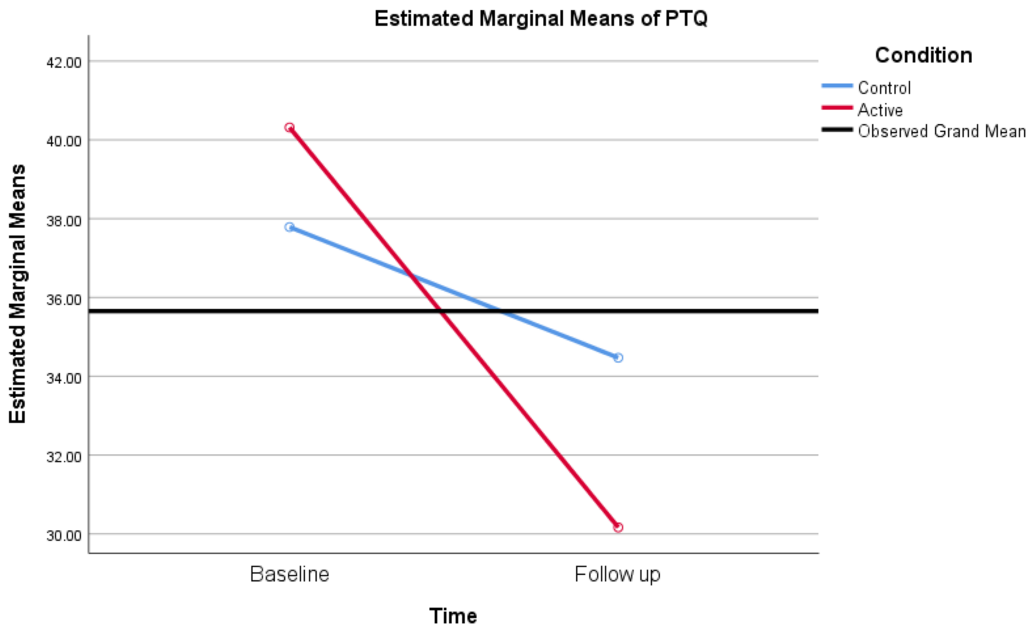


Figure 3.2

Estimated Marginal Means of AAQ

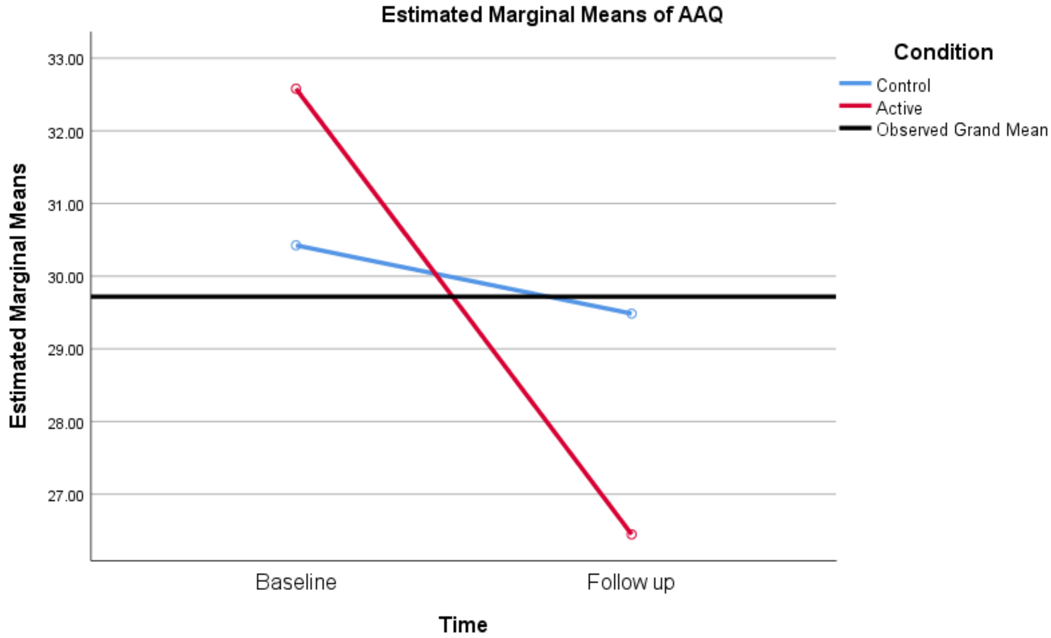


Figure 3.3

Estimated Marginal Means of DASS-Stress

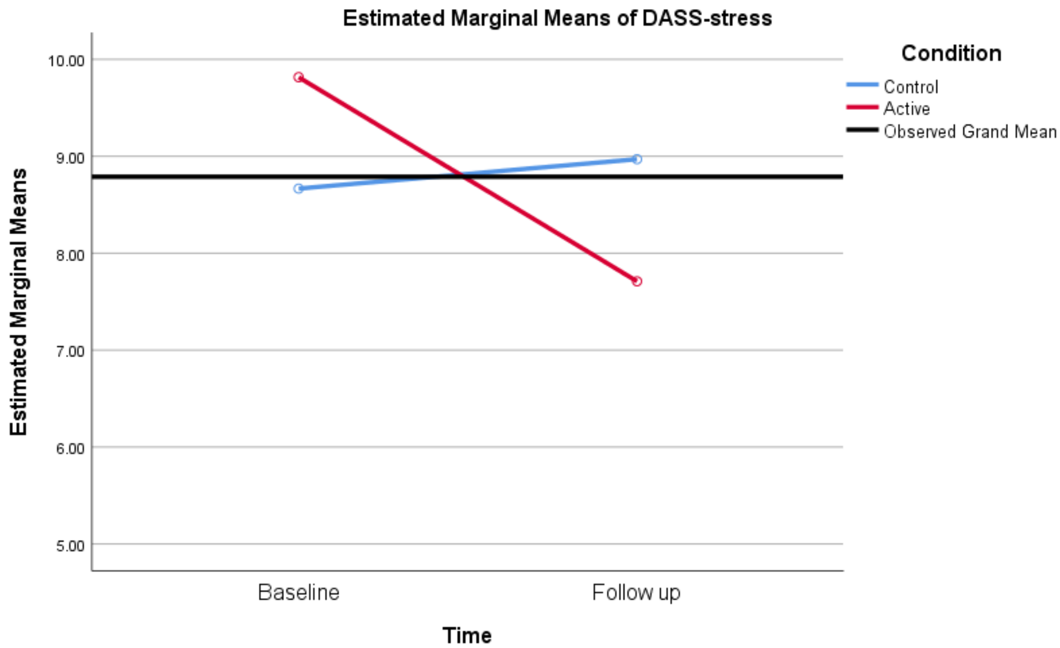


Figure 4.1

Scatter Plot of Predicted Values from Multilevel Model Predicting Momentary RNT Levels

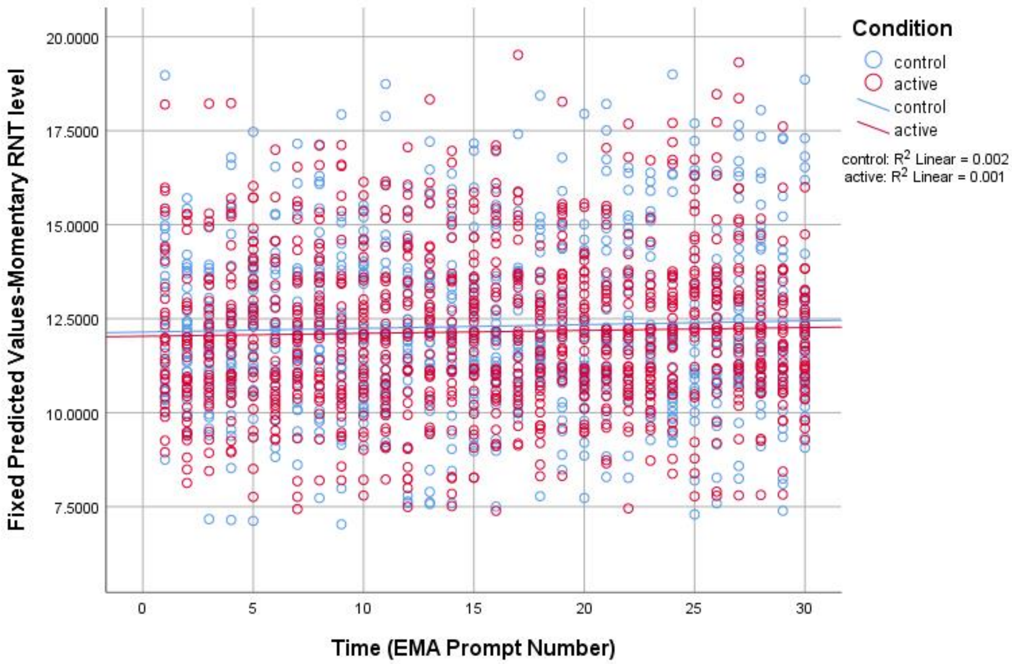


Figure 4.2

Scatter Plot of Predicted Values from Multilevel Model Predicting Momentary NA

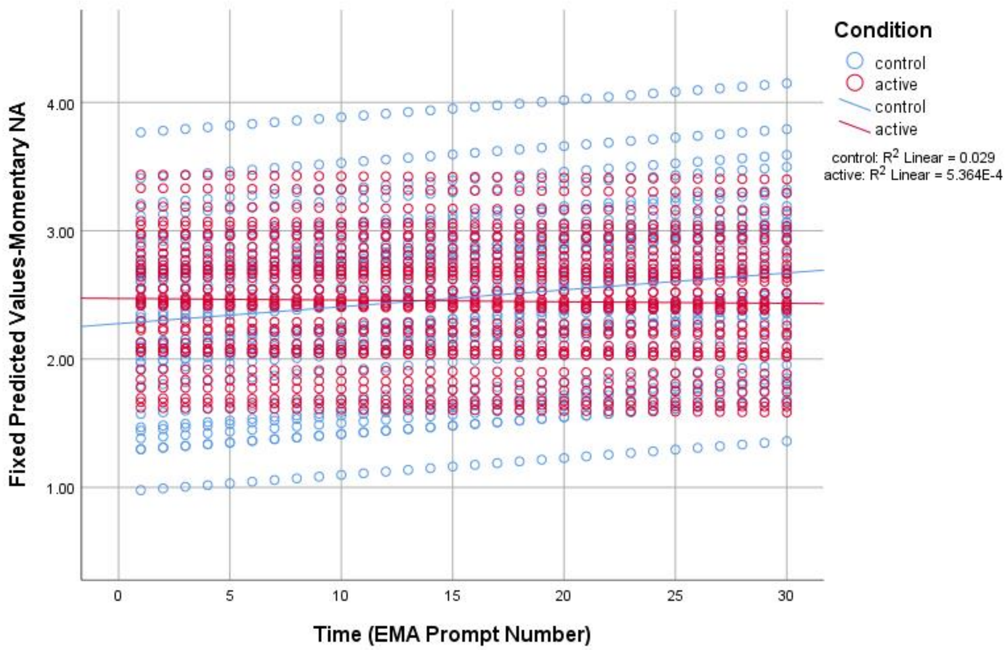


Figure 4.3

Scatter Plot of Predicted Values from Multilevel Model Predicting Noticing RNT

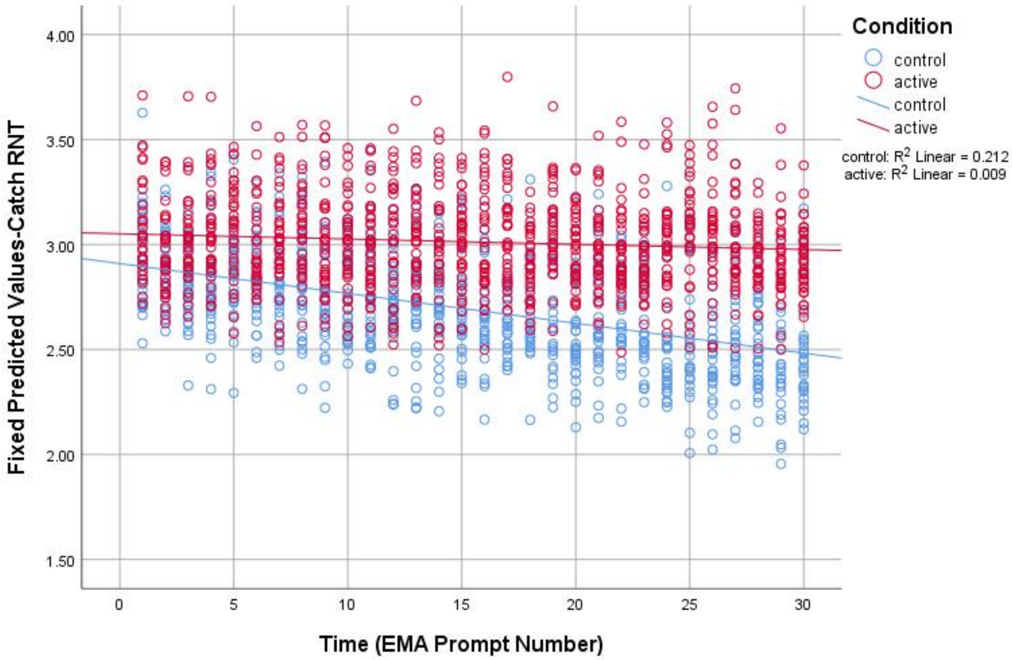


Figure 4.4

Scatter Plot of Predicted Values from Multilevel Models Predicting Skills Use When Notice RNT

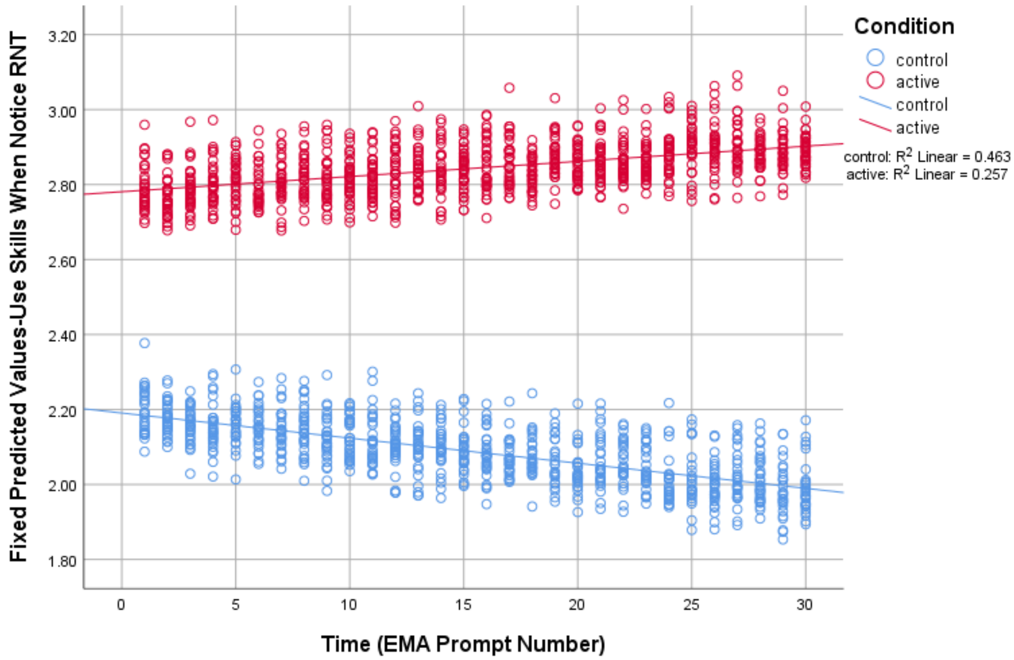
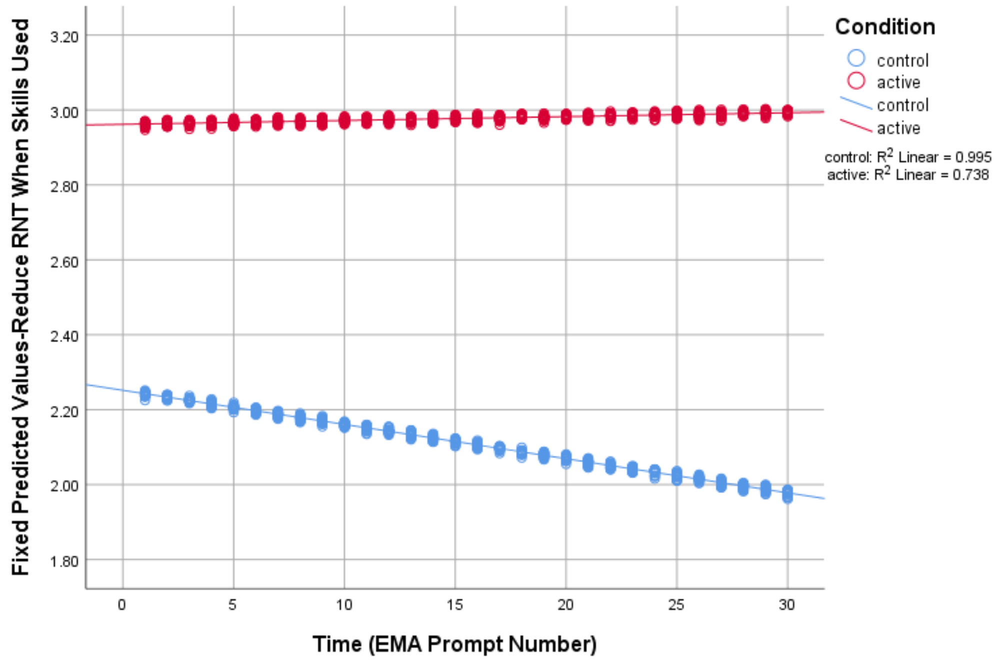


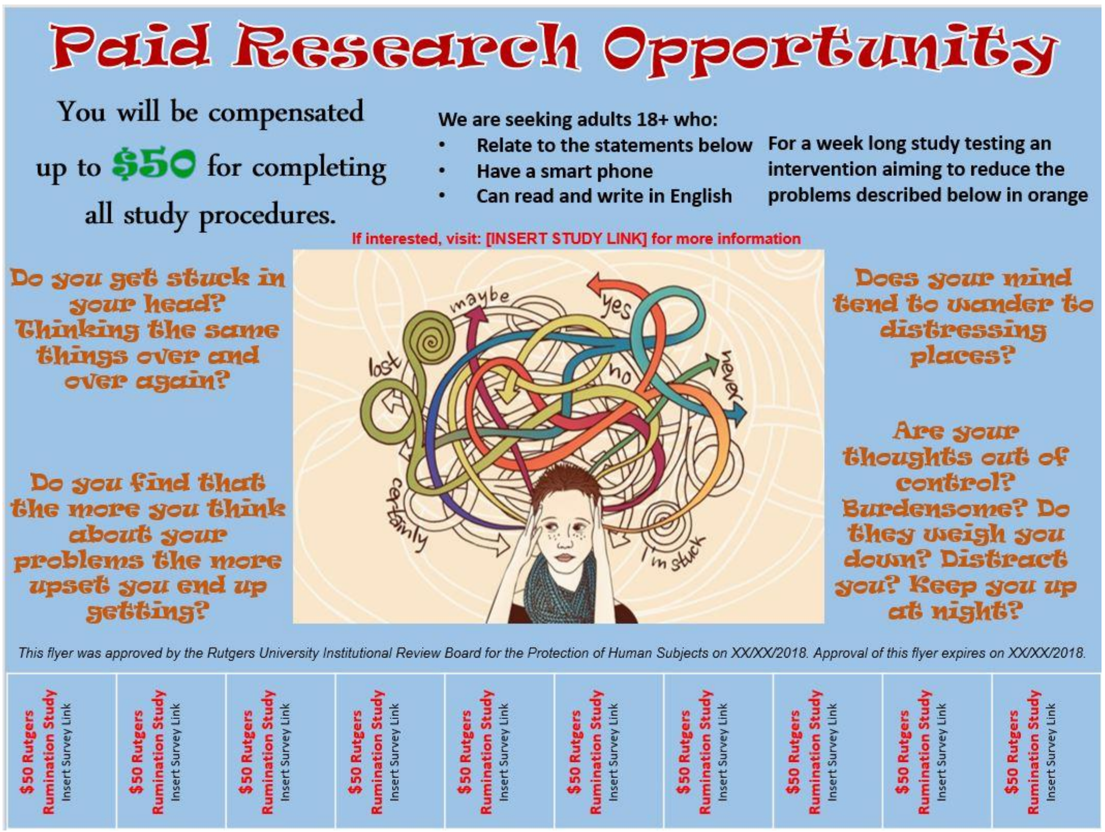
Figure 4.5

Scatter Plot of Predicted Values from Multilevel Model Predicting Reduction of RNT When Skills Used



Appendix 1

Recruitment Flyer



Appendix 2

Skills training video URL

www.tinyurl.com/RNTvideo