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### Recommended Citation

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**Mindfulness and Pain Regulation: The Role of Acceptance and Commitment Therapy for  
Individuals with Chronic Pain**

Ariana C. White

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Honors Thesis

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December 14<sup>th</sup>, 2022

**Mindfulness and Pain Regulation: The Role of Acceptance and Commitment Therapy for  
Individuals with Chronic Pain**

**Prepared by:**

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**In partial fulfillment of the requirements for the Bachelor of Science in Communication  
Sciences & Disorders *Honors-in-Major* at The University of New Hampshire**

Approved by:



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12/20/22

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12/19/22

Date

### **Abstract**

Chronic pain is a significant and widely prevalent health condition which requires comprehensive care to address the many facets contributing to symptomatology. In 2016, 20% of American adults (about 50 million) reported experiencing chronic pain, of which 7.4% indicated that chronic pain frequently limited their life and participation in activities within the past 3 months (CDC, 2018). As a result, many individuals with chronic pain turn to opioid-based medication for pain relief, but long-term use of opioids actually increases pain sensation (Tobin, 2019). Moreover, opioid medication is unable to target underlying mental health components which emerge as part of chronic pain conditions. Thus, non-pharmacological treatment is needed to relieve the burden of chronic pain and improve cognitive and emotional processing as well as views of self (Skelly et al., 2018). Acceptance and Commitment Therapy (ACT) is a highly effective transdiagnostic intervention used to treat chronic pain by teaching individuals coping skills through mindfulness and behavioral activation (Bai et al., 2020; Dindo et al., 2017). Based on extensive data, ACT is shown to correlate with an increase in psychological flexibility, pain acceptance, and reductions in feelings of pain-related stigma (Aytur et al., 2022; Ding & Zheng, 2022; Meier et al., 2021; Feliu-Soler, 2018). Given the necessity of remote healthcare intervention, especially relevant during the recent pandemic, there is an urgent need to evaluate the efficacy of ACT in a tele-practice delivery model which will broaden the availability of the treatment to reach far larger numbers of patients. As a complement to ACT, recreational therapy (RT) is likely efficacious for treatment of chronic pain and associated symptoms. Similar to the underlying goals of ACT, RT focuses on personal values, improved functioning, quality of life, independence, and recovery (Froutan, 2022).

The purpose of this paper is to expand upon a prior pilot study assessing feasibility of a non-pharmacological approach to chronic pain treatment using a tele-practice intervention that

combines ACT with RT (TeleACT-RT). Specifically, this paper will evaluate the efficacy of the TeleACT-RT intervention on improving mindfulness in participants with chronic pain. With a focus on the concept of mindfulness, this study aims to extend the previous findings from the TeleACT-RT study by quantifying the impact of ACT on metrics of mindfulness using the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2004, 2008).

Results suggest that TeleACT-RT was associated with a significant increase in mindfulness scores after the intervention, as well as improved scores in numerous other domains (e.g., psychological flexibility, pain acceptance, and social role participation) (Roy, 2022). These findings complemented prior research suggesting that TeleACT-RT was associated with a wide range of improvements in chronic pain. (Roy, 2022). Roy et al. (2022) explored the feasibility of administering this intervention through a 6-week tele-practice TeleACT-RT modality within the context of the COVID-19 pandemic through a pilot-study. Findings from this study revealed positive behavior outcomes, encompassing increased psychological flexibility, pain acceptance, and lower extremity function, while simultaneously showing decreased feelings of pain-related stigma (Roy, 2022). Additionally, participants reported being satisfied with the tele-practice modality of delivery and provided positive feedback regarding their overall quality of life post-treatment with ACT.

*Keywords:* Acceptance and Commitment Therapy, chronic pain, Recreational Therapy, tele-practice, pain management, neurobiology, mindfulness, FFMQ

## **Mindfulness and Pain Regulation: The Role of Acceptance and Commitment Therapy for Individuals with Chronic Pain**

### **Introduction:**

Chronic pain is a significant public health concern that has reached crisis levels, resulting in the need for greater access to interventions, such as ACT (Pizzo et al., 2011). The etiology of all types of chronic pain conditions is not fully understood, but research has identified risk factors, brain substrates, and underlying cognitive-behavioral processes that exacerbate the persisting pain and its associated impairments in cognition and emotion (Linton et al., 2018). Another critical aspect of certain chronic pain conditions is that they are cyclical in nature, with multiple recurrences over long periods of time (Linton et al., 2005, 2018). Chronic pain triggers emotions of fear, anger, and frustration, as well as catastrophic thinking which drives behavior and encourages the avoidance of aversive thoughts (Linton et al., 2018). The cyclical nature of chronic pain, in addition to the avoidance of negative feelings and thoughts, encourages learning; in turn, learned behavior and beliefs surrounding pain subtly influence routine behavior changes. This results in a feedback loop between negative feelings and pain sensations.

In addition to the nature of chronic pain conditions, it is known that many current treatments inadvertently contribute to the opioid epidemic; prescriptions for chronic pain can often lead to misuse and addiction to narcotics. For example, approximately 40% of opioid-related deaths are due to prescription use (Seth et al., 2018). Moreover, it is known that opioids do not result in significantly better pain-related function within the treatment of chronic pain (Krebs et al., 2018) and that long-term use of opioids actually makes pain conditions worse (NIDA, 2019). As such, several behavioral interventions have been used to help patients manage their chronic pain, including Cognitive Behavioral Therapy (CBT) and ACT (Knoerl et al., 2015; Vowles et al., 2014). As noted above, ACT has been well studied and is highly effective in

treating chronic pain. Importantly, while CBT has also been shown to result in positive outcomes, prior research suggests that patients are more satisfied with ACT (Bricker et al., 2014). Moreover, ACT has been shown to normalize brain function in face-to-face settings resulting in strong effect sizes (e.g., Aytur et al, 2022; Meier et al., 2021).

### **Mindfulness-based Therapy:**

Exploring the effect that mindfulness and meditation have on pain is advantageous to the population of individuals with chronic pain. Utilizing a control group, as well as a placebo and “sham” group, researchers have been able to gain a better understanding of the mechanism of influence of mindfulness. For example, Zeidan et al. (2015) conducted a placebo comparison to evaluate the efficacy of mindfulness meditation on pain reduction and whether the underlying analgesic mechanisms were different between groups. In this study, 75 healthy participants were randomly assigned to the following groups: 1) mindfulness meditation, 2) placebo conditioning, 3) sham mindfulness meditation, and 4) a book-listening control intervention. To investigate potential changes within participants, anatomical magnetic resonance imaging (MRI), functional brain imaging (fMRI), and a psychophysical evaluation of pain were assessed (Zeidan et al., 2015). MRI was used to acquire a structural brain image and allow participants to acclimate to the scanner prior to the functional tasks. During scanning, neutral and “heat” stimuli were administered in an alternating way. With this method, the noxious heat stimuli sessions were never acclimated to, and the imaging showed responses to unpleasant stimuli. MRI was specifically chosen during this study due to its ability to image steady cognitive states through perfusion, allowing deactivation to be measured (Zeidan et al., 2015; Luh et al., 2000). The Freiburg Mindfulness Inventory (FMI) is a psychometrically valid assessment which has high internal consistency and uses a Likert-type self-report scale. The FMI contains 14 items and a 14-point rating scale, ranging from 1 (rarely) to 4 (almost always) (Karatepe & Yavuz., 2019;

Zeidan et al., 2015; Walach et al., 2006). The FMI was designed to detect mindfulness changes following meditation, and was administered to participants in the mindfulness meditation and sham mindfulness meditation groups after each intervention (Zeidan et al., 2015). Pre- to postintervention findings showed greater pain reduction in the mindfulness meditation group postintervention than the placebo and sham mindfulness meditation groups. Both the mindfulness meditation and sham mindfulness groups experienced a significant reduction in respiration rate and cerebral blood flow. Imaging data revealed that regions associated with the Neuromatrix Model of pain (“the pain matrix”) were affected, including deactivations in the thalamus and periaqueductal gray matter regions (Trachsel, 2022). In addition, brain regions which modulate cognitive control or pain (anterior cingulate cortex, bilateral anterior insula, and putamen) were activated (Zeidan et al., 2015).

Continuing prior research related to mindfulness meditation and pain, Zeidan & Vago (2016) reviewed the attenuation of pain through meditation-based relief. The review highlights the advantages of narcotic-free pain relief, and the implications for the chronic pain population at large (Zeidan & Vago, 2016). Improvements in pain symptomology have occurred across a variety of pain-related disorders including migraine, fibromyalgia, chronic pelvic pain, and irritable bowel syndrome (Zeidan & Vago, 2016). Mindfulness meditation leads to the engagement of multiple neural mechanisms which subjectively diminishes pain in individuals, affecting sensory-related responses (Zeidan & Vago, 2016). Zeidan & Vago suggest that mindful meditation should reduce the opioid epidemic. This could lead to psychological improvements among individuals with chronic pain, as well as an overall improved quality of life.

Similar to Zeidan and colleagues, Su et al. (2016) studied the modulation of pain perception through mindfulness training, describing pain as an individualized experience. Su et al. (2016) specifically focused on mindfulness (without the added component of meditation). A



conceptual framework of pain used by Su and colleagues involves cognitive-evaluative, sensory-discriminative, and affective-motivational processing as critical components. This study used resting state fMRI and questionnaire-based data which were collected pre- and post-training of a 6-week mindfulness-based course on pain modulation. Results showed that individuals in the ‘pain-afflicted group’ experienced significantly lower pain sensation following treatment and experienced pain-reduction-induced emotional changes based on questionnaire data pre- to post-training. Results suggest that pain perception can be modulated through cognitive training (Su et al., 2016).

Furthering the research of pain regulation and mindfulness, Kober et al. (2020) explored mindfulness practice in the context of pain regulation and negative emotion. Deficits in emotional control have many consequences and coincide with numerous disorders such as anxiety, depression, addiction, and chronic pain (Gross, 2014; Kober et al., 2020). Mindful awareness and acceptance of one’s affective reactions is a regulation strategy which can be applied over various situations (Kober et al., 2020). Seventeen participants, with no prior meditation experience, were recruited for the study and given 30 minutes of training before they were scanned. Participants were exposed to two types of stimuli, negative vs. neutral images and painful vs. warm temperatures, and were given instructions indicating a natural or a mindful acceptance reaction (Kober et al., 2020). Results indicated a significantly lower negative response to both categories of stimuli (negative vs. neutral; painful vs. warm) when instructed to use mindful acceptance. This study has significant implications on the use of mindfulness within chronic pain due to results related to painful stimuli; a significant reduction in brain activity was noted in the pain network (e.g., medial frontal gyrus, anterior insula, posterior insula, sensorimotor regions, pre-supplementary motor area, dorsal anterior cingulate cortex, and thalamus) and cerebellum. The results from this study provide evidence that mindful acceptance

is an effective emotion-regulation tool which may alter both psychological and neural mechanisms of negative emotion and pain perception.

Neural changes in response to mindfulness are an important area of study. Identifying key areas in the brain which undergo neuroplasticity may help researchers understand the underlying brain regions involved in mindfulness and inform interventions (Kolb & Muhammad, 2014). Doll et al. (2016) investigated mindful attention to breathing and the subsequent effect on emotional regulation and the brain. The benefit mindfulness has for emotion regulation is acknowledged and the neural mechanisms are explored. To address the hypothesis that attention-to-breath (ATB) down-regulates activation in the amygdala and increases integration with prefrontal regions, 26 healthy controls were taught mindfulness-based ATB meditation for two weeks (Doll et al., 2016). After being trained, participants were exposed to unpleasant stimuli during passive viewing and ATB while undergoing an fMRI scan (Doll et al., 2016). Respiration was also measured during the process to determine the effects ATB had on breathing, achieved using a Respiration Belt Transducer; changes in respiration have a potential to affect the hemodynamic brain response, so this was an important factor to control (Doll et al., 2016). Results from the study indicated that ATB was an effective skill in emotion regulation. Regarding brain regions, the left dorso-medial prefrontal cortex (of the pain network) was associated with ATB, the fronto-parietal network was recruited when negative stimuli were administered, and ATB reduced amygdala activation and increased amygdala-prefrontal synergy. Further, results suggest a potential neural pathway associated with mindfulness-induced emotional regulation within the amygdala-dorsal prefrontal cortex (Doll et al., 2016).

Examining the underlying brain processes within physical and psychological health is accomplished in Kilpatrick et al. (2011). Researchers explored the benefits of mindfulness-based stress reduction (MBSR) on intrinsic brain connectivity and attention. This study randomly

assigned participants to either an 8-week MBSR training or an 8-week waiting period control group. After 8 weeks of the MBSR course, participants were scanned using fMRI (Kilpatrick et al., 2011). When compared with the control group, MBSR participants had increased functional connectivity within auditory and visual networks, as well as between the auditory cortex and salience network (Kilpatrick et al., 2011). Results also suggested negative correlations between the auditory and visual cortex, as well as the visual cortex and salience network (Kilpatrick et al., 2011). Findings may indicate an alteration of intrinsic functional connectivity after 8 weeks of MBSR training, reflecting enhanced attentional focus, sensory processing, and reflective awareness of sensations (Kilpatrick et al., 2011).

### **Acceptance and Commitment Therapy:**

ACT is a behavioral intervention that focuses on mindfulness and behavioral activation as guiding principles. Veehof et al. (2016) conducted a meta-analysis of acceptance- and mindfulness-based interventions in the non-pharmacological treatment of chronic pain. When compared with mindfulness-based stress reduction (MBSR) and mindfulness based cognitive therapy (MBCT), ACT showed significantly higher effects on depression and anxiety (Veehof et al., 2016). This meta-analysis found small post-treatment effects of these therapies in the reduction of pain intensity, depression, disability, and quality of life; moderate effects were observed for reduction of anxiety and pain-interference (Veehof et al., 2016). ACT was associated with a higher effect size when compared with MBSR and MBCT for all outcome measures (Luciano et al., 2014). ACT directly focuses on life values and committed action, components which may instill hope and promote behavioral change in participants (Veehof et al., 2016).

Exploring the changes in neural plasticity pre- to post-intervention was the focus of a study conducted by Meier et al. (2021). This study investigated neural plasticity post-ACT

intervention, specifically in individuals with a diagnosis of chronic pain. ACT is an intervention which captures the core properties of mindfulness. Individuals using ACT must focus on their values and attain psychological flexibility amid stressors. Psychological flexibility encompasses 6 core areas: acceptance, cognitive defusion, contact with the present moment, self-as-context, values, and committed action (Feliu-Soler et al., 2018). Current research is discussed linking reductions in chronic pain to ACT, achieved through reducing hyper-connectivity between the default mode network, fronto-parietal network, and salience network (Meier et al., 2021). Results from this analysis suggest decreased connectivity within the left putamen, right insula, left insula, and right thalamus, which is referred to as the pain network. ACT is proposed to normalize hyper-connectivity and alleviate pain node connectivity (Meier et al., 2021).

Adding to the results achieved by Meier and colleagues, Aytur et al. (2021) conducted a study to demonstrate changes within neural mechanisms pre- to post-ACT-intervention. Aytur et al. (2021) explores the use of this mindfulness-based therapy within the context of chronic pain, and the underlying changes in neural connectivity following intervention. Improved function was found across the default mode network, salience network, and fronto-parietal network, corresponding with self-reflection, emotion, and cognitive control, respectively. This study provides a mechanistic-based area of knowledge due to the results from the causal-mediation models. ACT was not originally designed to target chronic pain but has been described as an efficacious and “well-established” treatment for chronic pain according to the American Psychological Association (McCracken, L. M., & Vowles, K., 2014). Individuals with chronic pain not only fight against their daily experience of pain, but also their emotions, memories, feelings, and mental images about their pain (Feliu-Soler et al., 2018). A 4-week study was conducted on individuals who had been living with musculoskeletal chronic pain for 3 or more months. Patients engaged in two 90-minute ACT sessions per week administered by licensed

Certified Therapeutic Recreation Specialists (CTRS) who had been trained in ACT. Multiple validated assessment tools were used in this study to measure and assess behavioral outcomes, including the Acceptance and Action Questionnaire (Bond et al., 2011), the Chronic Pain Acceptance Questionnaire (McCracken et al., 2005; McCracken and Vowles, 2006; Vowles et al., 2008; Vowles and Thompson, 2011), the Center for Epidemiologic Studies Scale (Radloff, 1977; Vilagut et al., 2016), the NIH Toolbox Neuro-QoL scales (Cella et al., 2012), and the NIH Patient-Reported Outcome Measurement Information System Measures of Pain Interference (Amtmann et al., 2010, 2011; Aytur et al., 2021). Behavioral outcomes after ACT intervention revealed statistically significant improvement in scores in the realms of depression, satisfaction with social role, and pain acceptance (Aytur et al., 2021). There were also results indicating a reduction in pain interference as well as an increase in willingness to engage in activities amid pain. In addition to behavioral outcomes, significant network changes were also noted. Data from fMRI scans were collected pre- and post-ACT to measure changes in functional connectivity, with results suggesting reductions in brain activation within and between networks; networks involved include the default mode network, salience network, and fronto-parietal network (Aytur et al., 2021). Research conducted by Aytur et al. (2021) has significant implications on the effect mindfulness and mindfulness-based interventions have on chronic pain (Aytur et al., 2021).

Contributing to the pilot-research conducted by Roy (2022) involving tele-ACT and chronic pain, I have conducted an analysis of data from the Five-Facet Mindfulness Questionnaire (FFMQ) (Baer et al., 2008). The FFMQ is a psychometric tool and objective way to assess mindfulness. This questionnaire focuses on the five facets of mindfulness: observing, describing, acting with awareness, non-judgment of one's inner experience, and non-reactivity (Baer et al., 2004, 2008).

**Recreational Therapy:**

RT is an activity-based treatment approach which focuses on core values, improved functioning, quality of life, independence, and recovery (Sorensen, 1999; Bennett et al., 2022). Froutan et al. (2022) explores recreational approaches to pain intervention, focusing on burn injury-related complications. A randomized trial was conducted on 58 individuals, assigned to an intervention group or a control group. Recreational intervention was provided for two weeks, with three sessions per week. Pain anxiety was the main focus, and the Burn Specific Pain Anxiety Scale and Burn Specific Health Scale-Brief were administered before and after intervention. The quality of life (QOL) score was significantly higher in the group that received recreational therapy than in the control group, and improved QOL scores were found in physical, emotional, and social domains. The recreational therapy program is a promising intervention in improving quality of life and mental health in patients with burn injuries and pain anxiety.

**Importance of Tele-practice Delivery:**

Over the past few years, the COVID-19 pandemic has resulted in the need for tele-practice interventions for a variety of healthcare conditions. Many tele-practice modalities have been explored, with many studies on the effectiveness of this modality of delivery. Use of telemedicine and tele-dentistry have been crucial adaptations in response to the challenges from the pandemic. Not only has tele-practice been used with the general population effectively, but it is also being used for medical incidents on aircrafts, emergencies in train traffic, implemented when working with international aid projects, and can be applied to teach students in educational settings. The tele-practice delivery modality can be applied over numerous settings and within diagnostics, therapy, rehabilitation, decision-making consultations, and within education (Wolf et al., 2022).

Tele-practice has also been a crucial component to the field of mental health care. Conventional mental health care is expensive, so tele-practice-based care is a more affordable option which has been utilized by many individuals. A systematic review by Langarizadeh et al. (2017) evaluates tele-mental health care. This review depicted significant capabilities and described the effectiveness of the web-based approach. This approach has the potential to fill accessibility-based gaps and to advance innovation in the areas of data provision, screening and evaluation, interventions, as well as social support. It was found that tele-mental health care is both cost effective and an efficient solution for individuals with mental health-related concerns. Providing the option of tele-practice care alongside traditional care may open doors for many patients, as well as under-resourced communities and nations that experience barriers in accessing affordable care (Langarizadeh et al., 2017).

Traditional ACT intervention is delivered in-person and in a variety of settings. ACT is flexible and can be implemented in group, one-on-one, and workshop settings. ACT is utilized by a range of populations who may present with medical conditions such as diabetes, obesity, psychiatric disorders, and chronic pain (Dindo et al., 2017). The ability for ACT to adapt to multiple populations is a key factor to its transdiagnostic utility. Improving accessibility to receive ACT services even further would give underserved populations more resources for treatment (Dindo et al., 2017). One way to adapt ACT so that it can be extended to other populations is to use a tele-practice (Zoom-based) format for delivery. Not only has the development of -health been crucial in the time of COVID-19, but it also provides services to individuals with mobility deficits, transportation difficulties, and immune-related concerns. As such, our team has developed a tele-practice platform for ACT with RT components. Previous research from our lab (e.g., Roy et al., 2022) has explored the feasibility of a 6-week ACT via tele-practice that is combined with a recreational therapy (RT) intervention in a small group

(n=7) of people who were experiencing chronic pain from conditions including fibromyalgia, osteoarthritis, compression fractures, and musculoskeletal pain. Results from this study revealed positive outcomes including increased psychological flexibility, pain acceptance, and lower extremity function, as well as decreased feelings of stigma associated with pain. Participants also reported satisfaction with the tele-practice modality and delivery of ACT.

**Study Aims:**

The purpose of this paper is to evaluate the efficacy of TeleACT-RT intervention on improving mindfulness in participants with chronic pain, as well as provide rationale for the continued research of TeleACT-RT and implications for use in different populations. We hypothesize that FFMQ mindfulness scores of participants will significantly improve after completing the TeleACT-RT intervention. With a focus on the concept of mindfulness, this study aims to extend the previous findings from the TeleACT-RT study by quantifying the impact of ACT on metrics of mindfulness. Focusing specifically on mindfulness is important as it can be incorporated into a multitude of different intervention approaches. Mindfulness is an evidence-based way of regulating pain, so understanding changes in mindfulness scores pre- and posttreatment using the FFMQ can give us further insights with respect to improving quality of life. This study also explores the implications of incorporating ACT and RT interventions, a combination which has no existing data.



## Methods

Seven participants were recruited and agreed to attend Zoom ACT and RT sessions conducted by certified therapeutic recreation specialists (CTRS) trained in ACT. Participants had a variety of chronic pain conditions including fibromyalgia, osteoarthritis, compression fractures, and musculoskeletal pain, all of which contributed to chronic pain. The ages of participants ranged from 24 to 88 years old, with five participants 76 or older. Mindfulness data was collected using the FFMQ and scored pre- and post-intervention. Results from the FFMQ were analyzed using AI-Therapy Statistics Beta (<https://www.ai-therapy.com/psychologystatistics/hypothesis-testing/two-samples>). Sub domains of the FFMQ were also assessed pre- and post-intervention.

## Statistical Analysis

Statistical analyses were conducted using AI-Therapy Statistics Beta (<https://www.aitherapy.com/psychology-statistics/hypothesis-testing/two-samples>). The Shapiro-Wilk test of normality was used to assess whether the FFMQ and sub domains were distributed normally, and a same subject paired t-test (parametric) and two-tailed distribution were used. The significance level was set to 0.05 due to the small sample size.

**Table 1**

*Demographics of Participants*

Sex (n=7)	Age	Pain Condition
3 Male 4 Female	24-88	osteoarthritis musculoskeletal pain fibromyalgia compression fractures

### ***Five-Facet Mindfulness Questionnaire***

Study participants completed a battery of assessments before and after the TeleACT-RT intervention, but this paper will focus on the FFMQ self-report measure developed by Baer and colleagues. Out of the 7 participants in the study, 6 completed the FFMQ. The FFMQ is an objective psychometric assessment of mindfulness, and the role of mindfulness in specific domains of life. The FFMQ utilizes a 5-point Likert-scale and consists of 39 items belonging to five subcategories: observing, describing, acting with awareness, non-judgment of one's inner experience, and non-reactivity (Baer et al., 2004, 2008).

### **Participant Comments:**

In addition to the quantitative data collected from the FFMQ, qualitative data was also obtained from an open-ended survey with questions that asked participants to share what worked well for them, and what did not. Qualitative data was recorded post-intervention through interviews. Thematic analysis was used to assess participants' experiences during the TeleACT-RT intervention.

## **Results**

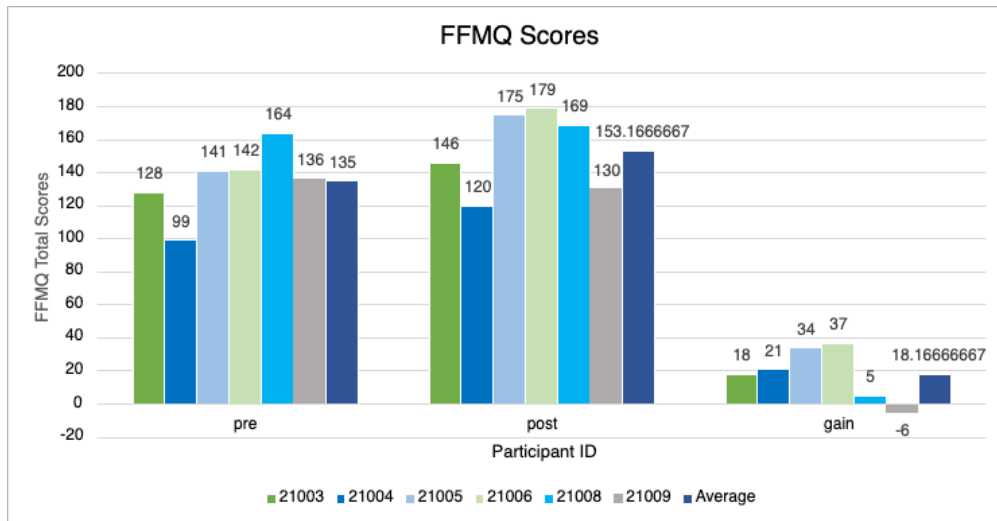
Differences in participant scores pre- to post-TeleACT-RT intervention were found to be statistically significant with a p-value of 0.043. A graph is included, with error bars within the 95% confidence intervals (see figure 8). It should be noted that one participant failed to respond to some questions administered on the FFMQ pre-intervention. Scores were calculated with and without the data from this participant. Without the "no response" participant data, there was no statistically significant difference between the pre-TeleACT-RT sample and post-TeleACT-RT

sample. A graph is included, with error bars outside of the 95% confidence interval (see figure 9). Next, we calculated significance in each sub domain of the FFMQ questionnaire: observing, describing, acting with awareness, nonjudging, and nonreactivity. Although there was no statistically significant change in any of the sub scores pre- to post-TeleACT-RT intervention (with or without the ‘no response’ participant); average scores pre- to post-intervention increased across each domain, indicating improvement. There was only one participant who didn’t experience an increase in their score after the intervention, which could be due to many different factors (e.g., difficulties using technology, missing appointments, problems accessing the tele-practice Zoom link, or general challenges with video-based tele-practice delivery).

With respect to qualitative data, several themes emerged. These themes related to perceptions of coping, pain acceptance, emotional agility, psychological flexibility, and self-efficacy. For example, one participant stated: “Mindfulness does help me to relax and although the pain may not go away completely, it doesn’t seem so bad after I use mindfulness techniques”. Another participant stated, “I have used mindfulness more frequently since the ACT program”. Mindfulness was mentioned again by another participant, “I think you’ve actually helped me set a new mindset with how to deal with this, a lot of the mindfulness and things that were taught in the lessons were very helpful...”. According to this qualitative data, participants were able to use mindfulness to better manage their experiences and sensations related to chronic pain.

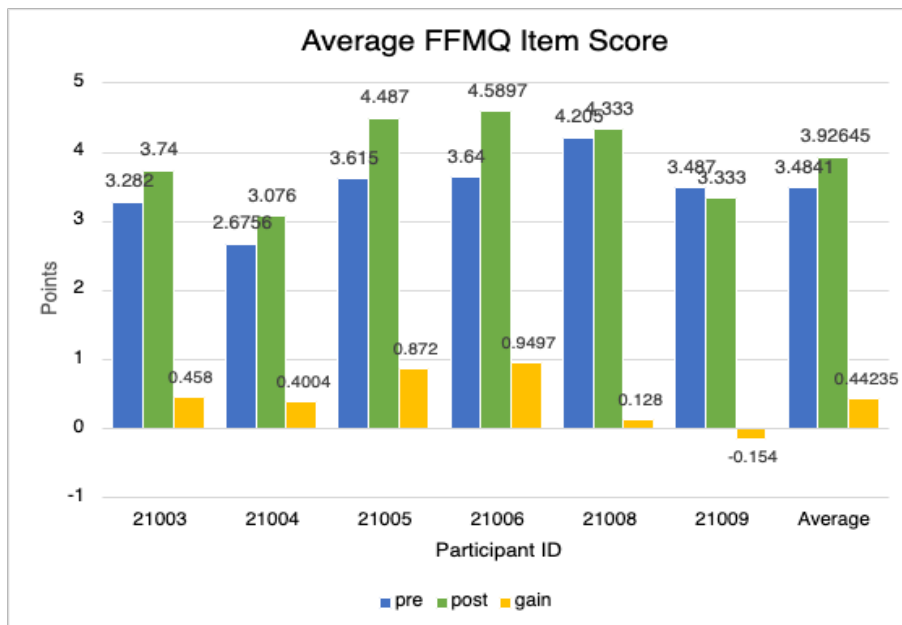
**Figure 1**

*FFMQ Scores Pre- to Post-Intervention*

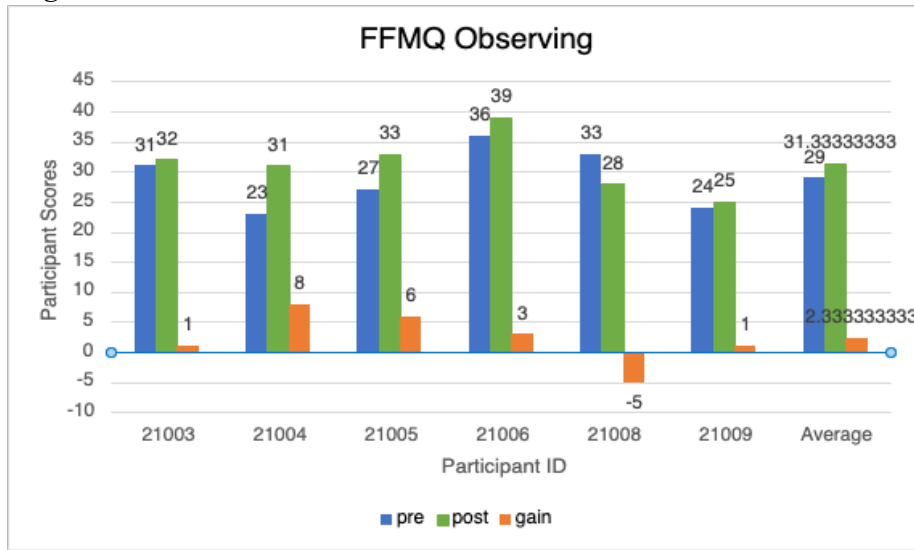


**Figure 2**

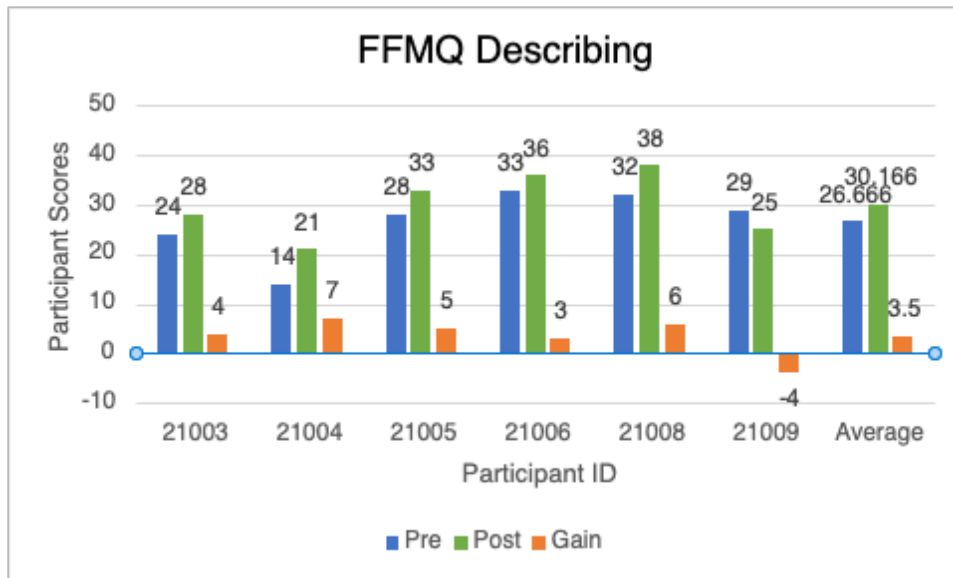
*Average FFMQ Score per Item Pre- to Post-Intervention*



**Figure 3**  
*FFMQ Observing Scores Pre- to Post-Intervention*

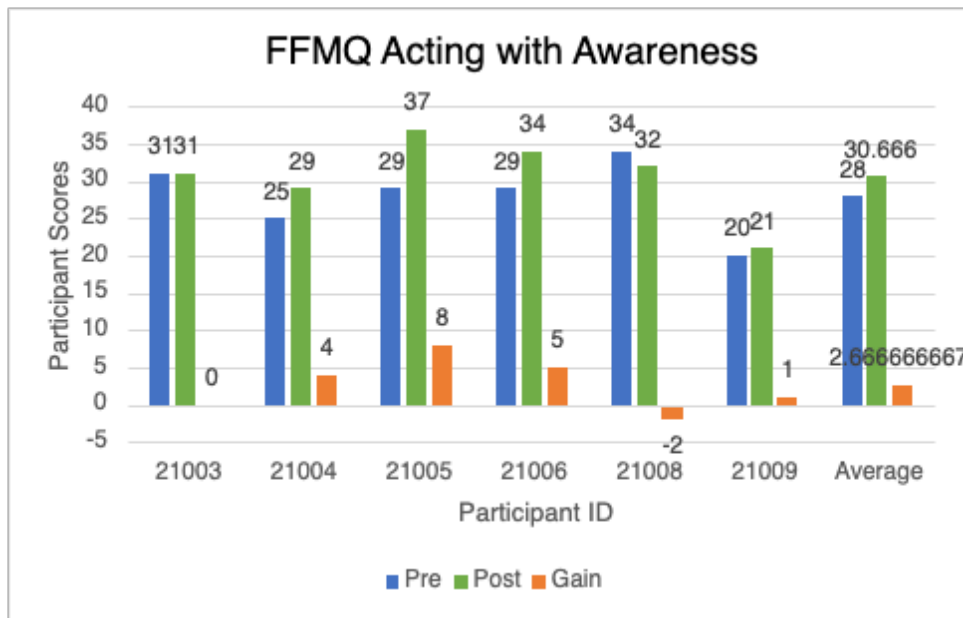


**Figure 4**  
*FFMQ Describing Scores Pre- to Post-Intervention*



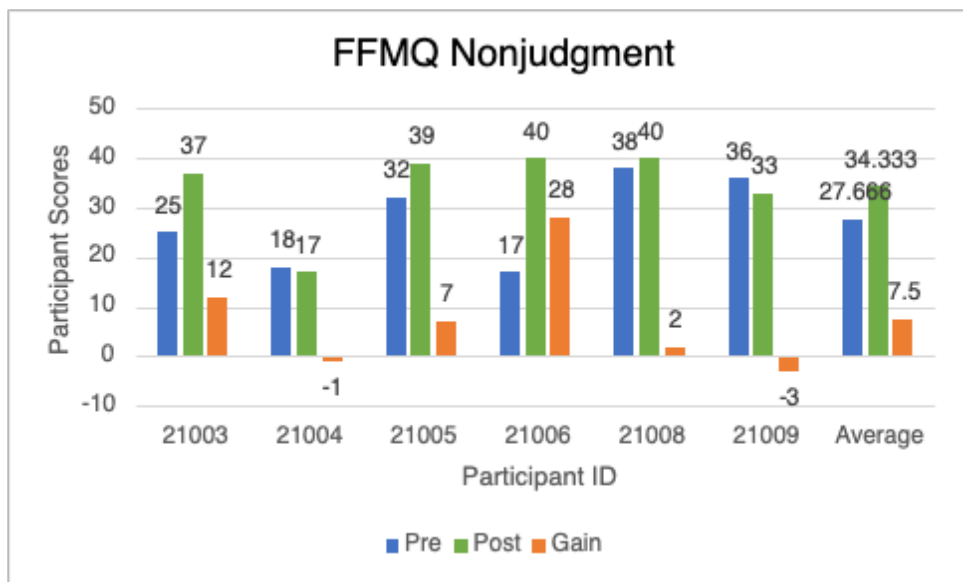
**Figure 5**

*FFMQ Acting with Awareness Scores Pre- to Post-Intervention*

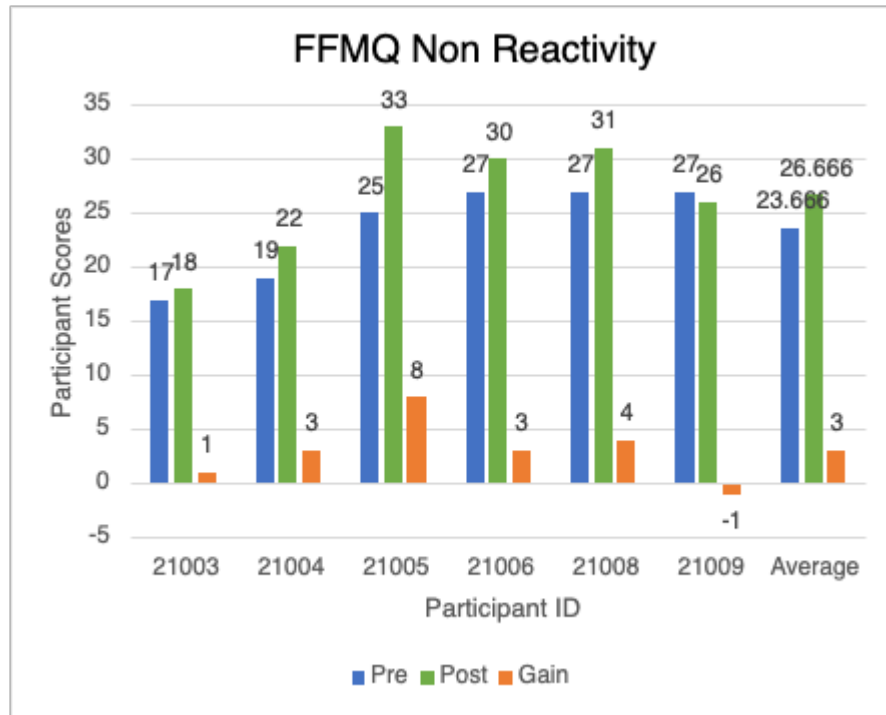


**Figure 6**

*FFMQ Nonjudgment Scores Pre- to Post-Intervention*



**Figure 7**  
*FFMQ Non-Reactivity Scores Pre- to Post-Intervention*



**Table 2**

(Key: *OBS* = observing; *D* = describing; *AA* = acting with awareness; *NJ* = nonjudgment; *NR* = nonreactivity)  
Pre-intervention FFMQ scores

<i>Participant ID</i>	<i>OBS</i>	<i>D</i>	<i>AA</i>	<i>NJ</i>	<i>NR</i>	<b>Total FFMQ</b>	<b>Average item score</b>
<b>21003</b>	31	24	31	25	17	128	3.282
<i>21004</i>	23	14	25	18	19	99	2.6756
<b>21005</b>	27	28	29	32	25	141	3.615
<b>21006</b>	36	33	29	17	27	142	3.64
<b>21008</b>	33	32	34	38	27	164	4.205
<b>21009</b>	24	29	20	36	27	136	3.487
<b>Average</b>	29	26.666	28	27.666	23.666	135	3.4841

Post-intervention FFMQ scores

<i>Participant ID</i>	<i>OBS</i>	<i>D</i>	<i>AA</i>	<i>NJ</i>	<i>NR</i>	<b>Total FFMQ</b>	<b>Average item score</b>
<b>21003</b>	32	28	31	37	18	146	3.74
<i>21004</i>	31	21	29	17	22	120	3.076
<b>21005</b>	33	33	37	39	33	175	4.487
<b>21006</b>	39	36	34	40	30	179	4.5897
<b>21008</b>	28	38	32	40	31	169	4.333
<b>21009</b>	25	25	21	33	26	130	3.333
<b>Average</b>	31.33333	30.166	30.666	34.333	26.666	153.1666	3.92645

Pre- to post-intervention FFMQ score change

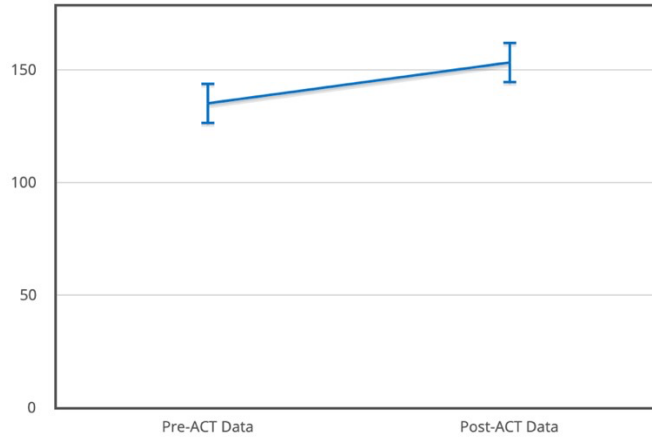
<i>Participant ID</i>	<i>OBS</i>	<i>D</i>	<i>AA</i>	<i>NJ</i>	<i>NR</i>	<b>Total FFMQ</b>	<b>Average item score</b>
<b>21003</b>	1	4	0	12	1	18	0.458
<i>21004</i>	8	7	4	-1	3	21	0.4004
<b>21005</b>	6	5	8	7	8	34	0.872
<b>21006</b>	3	3	5	28	3	37	0.9497
<b>21008</b>	-5	6	-2	2	4	5	0.128
<b>21009</b>	1	-4	1	-3	-1	-6	-0.154
<b>Average</b>	2.333333	3.5	2.666666	7.5	3	18.16666	0.44235

(Note: participant 21004 did not respond to some FFMQ questions, so scores were calculated with and without their data.)



**Figure 8**  
*Pre- to Post-Intervention Scores [including participant 21004]*

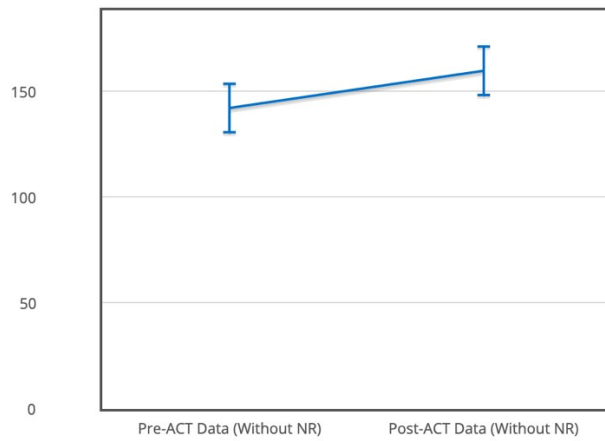
Visualization



The error bars in the graph above are 95% within-subject confidence intervals. (For more information on within-subject confidence intervals, see Loftus, G. R., & Masson, M. E. (1994). Using confidence intervals in within-subject designs. *Psychonomic Bulletin & Review*, 1(4), 476-490.)

**Figure 9**  
*Pre- to Post-Intervention Scores [excluding participant 21004]*

Visualization



The error bars in the graph above are 95% within-subject confidence intervals. (For more information on within-subject confidence intervals, see Loftus, G. R., & Masson, M. E. (1994). Using confidence intervals in within-subject designs. *Psychonomic Bulletin & Review*, 1(4), 476-490.)

### Discussion

The purpose of this study was to evaluate changes in mindfulness associated with the TeleACT-RT intervention for chronic pain. When including responses from all 6 participants, there was a statistically significant difference in scores pre- to post-intervention. Although the result without the “no response” participant was not statistically significant, possibly due to low power, participants’ scores were trending towards improvement across all FFMQ domains.

The body of literature involving mindfulness relative to pain is growing, and advancements in interventions, such as ACT and RT, have positive implications for the future of chronic pain management. The efficacy of mindfulness on the modulation of neural networks should be explored further, and within different populations. The statistical significance of TeleACT-RT on mindfulness scores in a larger sample size should also be assessed. Additionally, a specific population that may benefit from ACT intervention is within stroke patients. Individuals who have experienced a stroke may have difficulties leaving the house, partaking in leisure activities, activities of daily life, and numerous emotional domains (e.g., depression and anxiety). The concepts of ACT may provide support needed to improve quality of life in individuals with stroke. Moreover, a tele-practice modality may be especially important within this population if there are difficulties with mobility or leaving the house (Pound et al., 1998). Modifications would be crucial to ensure an appropriate intervention for individuals within this group, which may be achieved through means of telemedicine and/or other accessibility-related adaptations (e.g., if a PowerPoint is used to administer therapy, font size, contrast, and density of content should be addressed).

**Limitations:**

There were several limitations to this study, including a small sample size, which limited the power of the statistical analyses. One participant did not fully complete a pre-intervention FFMQ, there was no control group of participants, or 1-month or 3-month follow-up assessments (data which would have been helpful in determining maintenance of learned skills). Further research would be beneficial, with a larger sample size, a control group, and longitudinal follow-up assessments (e.g., 1 month, 3 months, 6 months) to measure sustainability.

Although the TeleACT-RT pilot study showed promising results, it should also be noted that a tele-practice modality may not be the best option for everyone. As such, there should be criteria to determine each participant's eligibility for using a tele-practice intervention. Technical factors such as access to a computer or Wi-Fi may cause difficulties. Personal factors such as difficulty understanding technology, inability to access a distraction-free space for therapy, and comfort-levels with sharing personal information in the environment from which therapy is conducted should also be considered (Haleem, 2021). Results from the present study suggest that TeleACT-RT increases accessibility for many individuals, but future research should continue to explore the barriers and enablers of tele-practice modalities.

**Conclusions:**

Overall, findings from this pilot study suggest that ACT and RT can successfully be delivered through tele-practice. Data from pre- to post-intervention mindfulness scores are promising; participants' scores trended towards improvement across all FFMQ domains. Qualitative data from participants provide additional evidence of improved mindfulness capabilities following the TeleACT-RT intervention. The delivery of ACT and RT via tele

practice may be an effective option for supporting persons experiencing chronic pain, with additional benefits such as reduced need for transportation to and from appointments.

The effectiveness and accessibility of TeleACT-RT should be explored further in future research with larger sample sizes, more diverse populations, and other types of chronic health conditions including stroke, diabetes, and syndemic stress.

**Acknowledgements:** We thank Tye Thompson, Sarah Meier, Grace Roy, Marcy Doyle, Barry Gendron, Kim Ray, Courtney Allard, the ACT participants, and our community partners for their assistance with this research. We also thank the UNH Collaborative Research Excellence (CoRE) program for helping to support this work.

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Appendix

Five-Facet Mindfulness Questionnaire



Five Facet Mindfulness Questionnaire (FFMQ)

Please rate each of the following statements with the number that best describes <i>your own opinion</i> of what is <i>generally true for you</i> .		Never or very rarely true	Rarely true	Sometimes true	Often true	Very often or always true
FFQM 1	When I'm walking, I deliberately notice the sensations of my body moving. (OBS)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 2	I'm good at finding words to describe my feelings. (D)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 3	I criticize myself for having irrational or inappropriate emotions. (NJ-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 4	I perceive my feelings and emotions without having to react to them. (NR)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 5	When I do things, my mind wanders off and I'm easily distracted. (AA-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 6	When I take a shower or bath, I stay alert to the sensations of water on my body. (OBS)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 7	I can easily put my beliefs, opinions, and expectations into words. (D)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 8	I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted. (AA-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 9	I watch my feelings without getting lost in them. (NR)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 10	I tell myself I shouldn't be feeling the way I'm feeling. (NJ-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 11	I notice how foods and drinks affect my thoughts, bodily sensations, and emotions. (OBS)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 12	It's hard for me to find the words to describe what I'm thinking. (D-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 13	I am easily distracted. (AA-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 14	I believe some of my thoughts are abnormal or bad and I shouldn't think that way. (NJ-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 15	I pay attention to sensations, such as the wind in my hair or sun on my face. (OBS)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 16	I have trouble thinking of the right words to express how I feel about things. (D-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 17	I make judgments about whether my thoughts are good or bad. (NJ-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 18	I find it difficult to stay focused on what's happening in the present. (AA-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1



		Never or very rarely true	Rarely true	Sometimes true	Often true	Very often or always true
FFQM 19	When I have distressing thoughts or images, I "step back" and am aware of the thought or image without getting taken over by it. (NR)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 20	I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing. (OBS)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 21	In difficult situations, I can pause without immediately reacting. (NR)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 22	When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words. (D-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 23	It seems I am "running on automatic" without much awareness of what I'm doing. (AA-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 24	When I have distressing thoughts or images, I feel calm soon after. (NR)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 25	I tell myself that I shouldn't be thinking the way I'm thinking. (NJ-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 26	I notice the smells and aromas of things. (OBS)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 27	Even when I'm feeling terribly upset, I can find a way to put it into words. (D)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 28	I rush through activities without being really attentive to them. (AA-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 29	When I have distressing thoughts or images, I am able just to notice them without reacting. (NR)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 30	I think some of my emotions are bad or inappropriate and I shouldn't feel them. (NJ-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 31	I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow. (OBS)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 32	My natural tendency is to put my experiences into words. (D)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 33	When I have distressing thoughts or images, I just notice them and let them go. (NR)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 34	I do jobs or tasks automatically without being aware of what I'm doing. (AA-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 35	When I have distressing thoughts or images, I judge myself as good or bad depending what the thought or image is about. (NJ-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 36	I pay attention to how my emotions affect my thoughts and behavior. (OBS)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5



		Never or very rarely true	Rarely true	Sometimes true	Often true	Very often or always true
FFQM 37	I can usually describe how I feel at the moment in considerable detail. (D)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
FFQM 38	I find myself doing things without paying attention. (AA-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
FFQM 39	I disapprove of myself when I have irrational ideas. (NJ-R)	<input type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1

**Scoring:**  
(Note: R = reverse-scored item)

Subscale Directions	Your Score TOTAL	Your score item Avg.
<b>Observing:</b> Sum items 1 + 6 + 11 + 15 + 20 + 26 + 31 + 36		
<b>Describing:</b> Sum items 2 + 7 + 12R + 16R + 22R + 27 + 32 + 37.		
<b>Acting with Awareness:</b> Sum items 5R + 8R + 13R + 18R + 23R + 28R + 34R + 38R.		
<b>Nonjudging</b> of inner experience: Sum items 3R + 10R + 14R + 17R + 25R + 30R + 35R + 39R.		
<b>Nonreactivity</b> to inner experience: Sum items 4 + 9 + 19 + 21 + 24 + 29 + 33.		
<b>TOTAL FFMQ (add subscale scores)</b>		

**NOTE:** Some researchers divide the total in each category by the number of items in that category to get an average category score. The Total FFMQ can be divided by 39 to get an average item score.

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*(1), 27-45.