Mindfully Attending to Variability: Challenging Chronicity Beliefs in Two Populations

Mindfully Attending to Variability: Challenging Chronicity Beliefs in Two Populations

A dissertation presented

by

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to

The Department of Psychology

in partial fulfillment of the requirements for

the degree of

Doctor of Philosophy

in the subject of

Psychology

Harvard University

Cambridge, Massachusetts

May 2019

Dissertation Advisor: Professor Ellen Langer Katherine Elizabeth Bercovitz

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Abstract

Six out of every ten adults in the United States are diagnosed with at least one chronic condition. These conditions are often considered incurable and are characterized by their persistence—with symptoms lasting over one year. With symptoms infiltrating day-to-day functioning, those with chronic conditions have no choice but to pay attention to them. The overarching question addressed in this dissertation is: Does it matter *how* someone pays attention to these symptoms?

In two studies, I investigated if the way in which someone pays attention to their symptoms affects health outcomes and perceived personal control. Specifically, I investigated how mindfully paying attention to symptom variability (versus stability) affects personal control and health outcomes. In Study 1, I focused on chronic pain patients and the effects of paying attention to how pain symptoms are fluctuating over time. In Study 2, I focused on older adults who are concerned about age-related memory decline. I discuss the effects of paying attention to how their memory performance is fluctuating over time.

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Acknowledgements

There are many people who made this journey possible. To those who smoothed the road before me without me ever knowing, thank you.

I'd like to thank my advisor, Professor Ellen Langer for welcoming me into her lab and sharing nuggets of research wisdom that she has collected (mindfully) over 50 years of her distinguished career. Thank you also to my dissertation committee members Professors Richard McNally, Leah Somerville, and Francesco Pagnini for their guidance and encouragement.

Next, I'd like to thank members of the Langer Lab who made collaboration fun and exciting, including: Karyn Gunnet-Shoval, Noga Tsur, Deborah Phillips, Chiara Haller, Christelle Ngnoumen, Chanmo Park, Dahua Wang, and Xiaomin Sun. I'd also like to thank the many research assistants who have volunteered in the lab over the years and provided tireless work and friendship including: Charles Choueiri, Hadley Johnson, Jacob Jones, Violet Fludzinkski, Ashale Portell, Rosemary Scalise, Anna Musser, Hannah Emerson, Hye Eon Park, Tim Martin, Melanie French, and Alissa Hiener.

Thank you to my students across three semesters of Sophomore Tutorial, who inspired me with their curiosity and work ethic. You helped me discover a love of teaching.

Thank you to my support network in Cambridge and outside of it, including: Helen Jing, Marie-Christine Nizzi, Monica Burns, Caterina Magri, Jayden Ziegler, Francesca Vitale, Lauren Jung, Crystal Campoverde, Katherine Kennedy, Amy Bernstein, Dudley House B-2 crew (Jackie Yun, Janet Daniels, Lindsay Guest, and Ahsley Skipworth), Aurora Sanfeliz at the Bureau of Study Counsel, Cindy Fiore, Bill Santoro, Celia Raia, Laura Chivers. Andrea Lynch, Laura Stark, and Heather Law.

Thank you to my original undergraduate research advisors, Professors Patti Simone and Matt Bell at Santa Clara University. You taught me the joys of answering original research questions. And thank you to Gerald and Sally DeNardo for making that research possible.

I'd also like to thank my family. Thank you especially to my mom, dad, and brother, Benjamin. Your unconditional love and support mean the world to me.

And finally thank you to my love, Eric Kittlaus. Our PhD journeys meant that we would be separated for six years, but our love grew even stronger. Thank you for your love and encouragement and for inspiring me every day with your optimism and curiosity.

For my students

Chapter 1. Personal control and mindfulness

1.1 Defining control

Researchers in the field of psychology have long investigated the phenomenon of personal control and have adopted many terms to describe the various theoretical nuances assumed under the concept of "control." These areas of research include the illusion of control (Langer, 1975; Langer & Roth, 1975), learned helplessness (Abramson et al., 1978; Seligman & Maier, 1967; Seligman, 1972), internal and external locus of control (Rotter, 1966), primary and secondary control (Rothbaum, Weisz, & Snyder, 1982), self-efficacy (Bandura, 1977), and self-mastery (Adler, 1927). The concept of locus of control is considered one of the most influential in the field of psychology, yielding over 4,000 original source articles and 20,000 citations on Google Scholar (Reich & Infurna, 2017). Personal control reflects individuals' beliefs regarding the extent to which they are able to control or influence outcomes. One important distinction made in this literature concerns the difference between actual (objective) control over one's life and one's perceived (subjective) control over one's life. There is much evidence to suggest that perceived personal control influences people's behaviors, emotions, and health more strongly than actual (objective) control (Kaplan & Camacho, 1983; Langer, 1975; McAndrew, Horowitz, Lancaster, & Leventhal, 2010). This chapter will focus on the effects of perceived personal control and how it relates conceptually to sociocognitive ("Langerian") mindfulness.

The illusion of control. The field of perceived control originated from a series of observations about how people try to control chance situations. In 1967, sociologist James Henslin observed that people attempted to control the outcome of a die roll (Henslin, 1967). Specifically, Henslin observed that people playing the game "craps" would throw the dice more softly when attempting to produce a low roll and more rigorously when attempting to produce a

high roll. Subsequent experimental investigations have shown that when a chance-governed situation incorporates characteristics relevant to skill-determined situations (e.g., choice, familiarity, involvement, competition), people often respond to the situation as if it is skill-determined and behave as though they can control these chance events. This skill orientation in a chance situation was coined as the "illusion of control" (Langer, 1975). Langer's research on the illusion of control provided empirical support for this view and has shown it to be even more extensive than Henslin originally suggested.

Some examples of how people apply these so-called "skill orientations" in chance situations include actively engaging with the experience and familiarizing themselves with the materials. In one study, participants were given the chance to select a lottery ticket and were then given the opportunity to exchange the ticket for one they were told had a better chance of winning (Langer, 1975). Despite the increased odds associated with the new ticket, participants were significantly more likely to keep their original ticket. This was the harbinger of the endowment effect (e.g., Carmon & Ariely, 2000).

In a similar vein, studies have demonstrated how participants mistake good luck for skill (Langer & Roth, 1975; Myers & Fort, 1963). Myers and Fort (1963) presented participants with a series of gambles and the option of accepting or rejecting any particular gamble. Participants were shown the outcome of each trial whether or not the gamble was accepted. They found that if participants had accepted the previous gamble and won, they were more likely to accept the next gamble compared to it if they had accepted and lost, even though in a chance-based task winning or losing should not influence confidence on subsequent trials because trials are independent. Langer (1975) found that participants were more confident that they would win a game of chance when playing against an awkward confederate as opposed to a more confident

one. Participants were also more likely to rate a chance game (e.g., predicting a series of coin tosses on a fair coin) as one requiring skill when having a series of initial successes (Langer & Roth, 1975).

The associated advantages of feeling in control suggest that the illusion of control is an adaptive process. Some researchers have argued that positive illusions, such as our failures to recognize our incompetence and our tendency to overestimate our ability to control events, are evolutionarily adaptive errors that have served us in creating and maintaining a sense of consistency--and thus reducing negative emotional experiences--as we navigate the world (Ehrlinger & Dunning, 2003; Taylor et al., 1988). Illusions of control can be viewed as adaptive biases, insofar as they enable people to feel hopeful in situations where they perceive uncertainty and risk. Illusion of control may also be especially beneficial in young adults, as they may work harder than if they believed that others (or chance) dictated the outcome of their effectors (Langer, 1975). Research finds that people who feel they have control of a situation are likely to exhibit behaviors that will better enable them to cope with potentially threatening situations compared to those who believe that chance or other non-controllable factors determine whether their behavior will be successful (Monty, Rosenberger, & Perlmuter, 1973). It is not surprising, then, that perceptions of personal control is associated with a host of salubrious psychological and physical effects, which are discussed below.

1.2 Psychological and physical health effects of personal control

Physical health and perceived control. Psychological theory and subsequent research investigations demonstrate that personal control beliefs strongly predict future behavior, health, and illness (e.g., Infurna, Ram, & Gerstorf, 2013). Perceived control has been associated with psychological and physical health in a large body of research, starting in the late 1960s (Glass et

al., 1969; Langer & Rodin, 1976; Langer et al., 1975; Rodin & Langer, 1977; Langer, Janis, and Wolfer, 1975). Personal control is a key protective factor for well-being, with individuals with higher levels of global perceived control reporting more control over their health (Infurna & Gerstorf, 2013). As a result of feeling more control, these individuals may be more likely to adopt and maintain healthy behaviors, such as exercising, following a healthy diet, and adhering to the advice of medical professionals (Bandura, 2004; White, Wójcicki, & McAuley, 2012).

A greater perception of personal control results in a decreased risk of physical decline and cardiovascular disease (Infurna & Gerstorf, 2014; Lachman & Agrigoroaei, 2010), as well as better neuroendocrine functioning and immunocompetence (Agrigoroaei et al., 2013; Bollini, Walker, Hamann, & Kestler, 2004; Wiedenfeld et al., 1990) and grip strength (Infurna & Gerstorf, 2014).

Researchers have also linked higher levels of perceived control with better cognitive functioning, including memory ability, executive functioning, and processing speed (Caplan & Schooler, 2003; Lachman & Agrigoroaei, 2012; Langer, Rodin, Beck, Weinman, & Spitzer, 1979).

Perceived control has been established as a key component of health throughout the life span (Heckhausen & Schulz, 1995) and is particularly emphasized in the literature as important for the older adult population. The first investigations in this domain began in the 1970s and have continued to influence the field. These first studies demonstrated the robust health benefits to restoring personal control to elderly nursing home residents by providing them with more responsibilities and choices over their care experience (Langer & Rodin, 1976). Specifically, those in the experimental group were invited to take personal responsibility for their care and living arrangements, including placement of the furniture, choosing the timing of a movie

showing, and how they wanted to spend their time. Finally, they were given the responsibility for caring for a plant. Those in the control group were told to take advantage of the amenities of the institution, specifying that it was the staff's responsibility to create the best environment possible, including caring for the new plants. The primary difference between the two groups was the degree to which personal control over the environment was emphasized. In addition to better health, activity patterns, mood, and sociability, older adults who were encouraged to take more personal control over their environment were less likely to die over the next 18 months (Langer & Rodin, 1976; Rodin & Langer, 1977).

In line with those results, Kaplan and Camacho (1983) found that perceived health predicted mortality even more strongly than actual health. Regardless of their actual health status, older adults who perceived their health to be poor were six times more likely to die than those who perceived themselves to be in excellent health (Idler & Kasl, 1991). Moreover, researchers have found that feeling in control of one's life led to greater late-life well-being and a later onset of terminal decline, independent of factors that are usually key to mortality including age, gender, SES, and disability (Gerstorf et al., 2014). One primary mechanism that researchers have put forward regarding the relationship between perceived control and decreased mortality is more effective regulation of stressors. Impaired control of stressors leads to increased activation of the HPA axis and more allostatic load, which accompany many diseases (Cohen, 2000; Juster, McEwen, & Lupien, 2010).

Parallel to the work on good health and mortality is a literature investigating the role of control in the experience of pain. Specifically, perceived control is one of the key factors that influences the experience of both acute and chronic pain (Gatchel, Peng, Peters, Fuchs, & Turk, 2007; Williams, Golding, Phillips, & Towell, 2004). Painful stimuli that are objectively

uncontrollable are perceived as more distressing and intense than controllable stimuli (Carlsson et al., 2006). To be effective in reducing pain, control over the stimulus can be perceived as instrumental, as is the case when it is possible to implement a behavioral response (e.g., interrupt the stimulus), or cognitive, when there is a cognitive strategy available (e.g., distraction; Litt, 1988). As reported in other situations, actual methods of exacting control do not have to be provided; they just needs to be perceived as available (Thompson, 1981).

In chronic pain patients, perceived helplessness is generally the strongest predictor of disability and pain level (Samwel, Evers, Crul, & Kraaimaat, 2006; Turner, Jensen, & Romano, 2000). Clinical implications are relevant, as health care professionals could support the perception of control in patients, for example by making them more engaged in the care process or in other activities where they can be have control (McCracken & Eccleston, 2005). It should be noted, however, that if multiple attempts of gaining control over pain fail, that can exacerbate frustration and pain (McCracken, Carson, Eccleston, & Keefe, 2004). Rather than trying to control pain itself, sometimes it could be preferable to try to gain control over the effect of pain on one's life (Gatchel et al., 2007). For more on perceived control and the chronic pain experience, see Chapter 3.

Psychological health and perceived control

In addition to physical health, a large body of research has investigated the relationship between perceived control and psychological health. Several psychological outcomes generally associated with well-being seem to be related to a sense of control over one's life. Among these outcomes are resilience, motivation, and life satisfaction across the socioeconomic spectrum (Lachman & Weaver, 1998) and across a variety of cultures (Cheng, Cheung, Chio, & Chan,

2013). Perceived control has been shown to help one to adapt to a variety of stresses including economic stress, job loss, and caregiver burden (Zautra et al., 2012).

For example, laboratory experiments have demonstrated that stress tolerance is related to perceived control over aversive stimuli. Specifically, participants who were able to administer the timing of shocks reported less anxiety than participants who were not in control of the shock (i.e., when the experimenter admisintered the shock; Pervin, 1963). In the clinical realm, anxiety and depression have both been linked to low levels of perceived control (e.g., Brown & Siegel, 1988). Low perception of control seems to be a constant across people with many different anxiety disorders (for a meta-analysis see Gallagher et al., 2014), suggesting that those suffering from these disorders may benefit from increasing their perception of control. These and other psychological distress may be reduced by increasing a sense of control (Averill, 1973), either through promoting coping behavior or initiating a reappraisal process (Bandura, 1982). Langer, Janis, and Wolfer (1975) demonstrated the integrations of these strategies in patients preparing for surgery. Specifically, they found that a comprehensive strategy consisting of cognitive reappraisal, calming self-talk, and selectively attending to the more favorable aspects of the present situation led to lower pre- and post-operative stress levels and quicker recovery.

Adopting a sense of control over one's past, present, and future circumstances in equal measure does not seem to optimally benefit those suffering from anxiety. In the temporal model of control, Frazier and colleagues (2002) hypothesized that perceived control over past events (i.e. self-blame, "What could I have done to prevent this?") may lead to more distress, while control over the present (i.e. "What can I do now?") and future (i.e. "How can I prevent this from happening again?") may lead to less distress. Indeed, longitudinal data from a sample of female sexual assault victims supported this temporal model of control, with higher levels of perceived

control over the past sexual assault related to more distress, and more perceived control over present (recovery) or future circumstances related to less distress (Frazier, 2003). Two studies found that perception of present control (but not past or future control) was related to reduced posttraumatic stress symptoms (Frazier, Steward, & Mortensen, 2004; Najdowski & Ullman, 2009). Similarly, Larsen and Fitzgerald (2010) found that for women who had been sexually harassed, perceived control over the recovery process along with the perception that future harassment was unlikely were both linked to fewer posttraumatic stress disorder symptoms.

In the context of panic disorder, experimental research has demonstrated that giving patients more control over their environment reduces symptoms. For example, Sanderson and colleagues (1989) found that when exposing panic disorder patients to a stressful environment conducive to panic (i.e. a 5.5% carbon-dioxide enriched atmosphere), patients who were lead to believe that they were able to change carbon-dioxide levels with personal dials demonstrated fewer symptoms, including fewer catastrophic cognitions and fewer reports of a panic attack. Not surprisingly, compared to a non-clinical sample, those diagnosed with panic disorder and social phobia reported a lower sense of internal control as measured by Levenson's (1973) locus of control scale. Specifically, those diagnosed with panic disorder perceive that events are proceeding in a random and uncontrollable way, while those diagnosed with social phobia perceive interactions as controlled by more powerful others in the form (e.g. those who judge them; Cloitre, Heimberg, Liebowitz, & Gitow, 1992).

Another anxiety disorder, obsessive-compulsive disorder (OCD), has been previously characterized by the patient's relationship with control. Specifically, OCD is characterized by an individual's attempts to control one's own thoughts and one's environment through rituals (Carr, 1974; Reuven-Magril, Dar, & Liberman, 2008). Researchers have suggested that clinicians use

cognitive therapy to help their patients find alternative ways to increase sense of control (Moulding & Kyrios, 2007).

Along with anxiety, low perceived control is also related to depression, as described in detail by Seligman's application of learned helplessness theory to those with depressive disorders (e.g., Miller & Seligman, 1975). Specifically, Seligman ascribed depression to feelings of helplessness over one's life circumstances. Later, Seligman described how one's attributional style could predict whether or not learned helplessness would occur. Seligman and Abramson (1979) found that individuals who view the etiology of negative events as internal, global and stable (i.e. displaying a pessimistic attributional style) were more likely to exhibit symptoms of depression than those with an optimistic attribution style (i.e., belief that causes of negative events are external, specific, and unstable). Researchers have demonstrated that depressive symptoms may be attenuated with interventions that aim to improve mastery and personal control (Zautra et al., 2012).

1.3 Increasing personal control

Given the importance of the construct of personal control, researchers have investigated how to increase it, both in the laboratory and outside of it. In the laboratory, one successful technique researchers have employed in order to experimentally increase perceptions of control is simply telling participants that they have control over various features of the immediate environment. For example, Bollini and colleagues (2004) manipulated perceived control by giving participants a button that purportedly reduced the volume over a speaker. Even though the button did not actually reduce the volume, participants believed that the button would produce this effect since the noise fluctuated throughout the session. Importantly, a manipulation check showed that participants were 54% more likely to report feeling control during the trials

they were given access to this button as compared to the trials in which they were not given access to this button.

Researchers have also experimentally manipulated perceptions of control by manipulating the actual controllability of the task/environment at hand. While participants in the noise dial experiment described above (Bollini et al.,2004) were given only the perception of control over the environment, participants in other experiments were given actual control. For example, researchers manipulated the controllability of a driving simulator by altering the program to simulate slippery driving conditions (Agrigoroaei et al., 2013). Specifically, the researchers created a "low controllability" group by lowering the coefficient on the road friction (.4) and adding wind gusts. This "low controllability" group was compared to a "normal controllability" group for whom the road friction was doubled (.8) and the wind gusts were removed. The researchers' manipulation check showed that those in the "low controllability" group, indeed, had lower scores (than the "normal controllability" group) on a question asking them how much control they believed they experienced during the driving portion of the experiment.

Researchers have also manipulated the construct of perceived control in the laboratory setting by asking participants to think about control in their lives, either by remembering recent events (Kay, Gaucher, Napier, Callan, & Laurin, 2008) or by simulating the self in different hypothetical scenarios (Laurin, Kay, & Moscovitch, 2008). Kay and colleagues (2008) found that participants who were asked to recall a recent positive event from their lives that they had control over exhibited more endorsement of beliefs of personal control compared to those who were asked to recall a recent positive event that they did not have control over. Instead of using actual life events, Laurin and colleagues (2008) asked participants to read hypothetical scenarios.

Specifically, those in the "low personal control" condition read scenarios that emphasized low amounts of personal control in stressful hypothetical scenarios (e.g., being chased by an attacker and having the police come to the rescue) while those in the "high personal control" condition read the same scenarios that emphasized more personal control (e.g., being chased by an attacker and taking the initiative to call 9-1-1 so that the police will come to the rescue). The authors found that participants who read the "low personal control" scenarios indeed were less likely to endorse personal control beliefs than those who read the "high personal control" scenarios.

Researchers have also investigated the role of mood in inducing perceived control. Specifically, researchers found that in depressed individuals, a positive mood induction led to more judgments of control over an uncontrollable, positive event (i.e., winning the lottery, Alloy, Abramson, & Viscusi, 1981).

In line with the temporal model of control (Frazier et al., 2002), planning for the future has also been investigated as a way to increase personal control (e.g, Bandura, 1997; Lachman & Burack 1993). Prenda and Lachman (2001) found that the effects of future planning on life satisfaction were mediated by perceived control, suggesting that planning may facilitate perceptions of control, which, in turn, increase life satisfaction. Similarly, encouraging decision-making has been shown to increase perceptions of control (Schulz, 1980). Much like Langer and Rodin's original 1976 study, Schulz gave nursing home residents control over the timing of volunteer visits.

Experimentally manipulating perceptions of control outside of the laboratory has been another major topic of inquiry. Increasing the amount of information an individual has access to has been shown to increase perceptions of control in surgery patients (Johnson, 1975). Specifically, when gastroendoscopy patients received precise descriptions of anticipated

reactions and medical procedures they experienced less pain, less need for medication following surgery, and less time in post-operative recovery than participants in the control groups (Johnson, 1975).

Researchers have also demonstrated how cognitive restructuring can be beneficial in increasing perceptions of control. The first of these interventions was implemented by Langer and Rodin in a nursing home setting (Langer & Rodin, 1976). By emphasizing the amount of control residents had over their own health and well-being and encouraging them to make their own decisions about their care, the researchers produced notable positive health changes in their participants, including reduced mortality at a 18-month followup (Rodin & Langer, 1977). While Rodin and Langer (1977) did not specifically measure beliefs about control as a primary outcome, Rodin (1983) found that training older adults to challenge negative beliefs about their abilities, self-regulation and coping skills showed a positive relationship between decreased cortisol and increased ratings of perceived control, as well as better health.

Similarly, Schultz (1976) found that giving nursing home residents control over the scheduling of volunteer visits led to better health metrics as provided by the activities director than those in the comparison groups. However, following up with the participants demonstrated the detrimental effects of removing control from those who have it (Schulz & Hanusa, 1978). Specifically, the researchers found that at the three timepoints after the volunteers stopped visiting (i.e., at 24, 30 and 42 months), the group who was given control over the visiting schedule not only did not maintain their gains, but actually fared worse than those in the comparison groups. This study highlighted the ethically challenging aspects of control interventions. Perhaps one difference between this follow-up and that of Rodin and Langer (1977) was that Schulz (1976) manipulated the amount of control of a single decision, whereas

Langer and Rodin (1976) emphasized personal control of their entire care experience, a comprehensive cognitive restructuring.

In the domain of memory, Lachman and colleagues found that the most effective memory training was one that not only taught memory skills, but also emphasized the amount of control an individual had over their memory performance (Lachman, Weaver, Bandura, Elliott, & Lewkowicz, 1992). At followup, participants in this group evidenced increased beliefs about memory controllability (specifically beliefs about improvement being possible, effort improving outcomes, and decrement being preventable). In the domain of falls, researchers found that teaching older adults how to think more positively about their abilities and the amount of control they had over future falls produced more positive health outcomes than those in the control group (Tennstedt, Howland, Lachman, Peterson, & Jette, 1998). Specifically, the researchers conducted a randomized control trial with older adults who reported a fear of falling and activity restriction. The participants who were taught cognitive restructuring techniques alongside strength-training exercises showed less intention to restrict activity and more perceived control over mobility as compared to a control group who were provided the same amount of social contact. Notably, individuals in the experimental group did not express that they felt more control over their falls as compared to the control group immediately after the intervention, nor at the followup timepoints (i.e., 12 weeks and 12 months). This finding suggests that perhaps the cognitive restructuring did not help by increasing perceptions of control, but by some other mechanism.

One area that has received little attention is the possibility of manipulating perceptions of control through mindfulness instruction. I discuss the relationship between mindfulness and personal control in the section below.

1.4 Mindfulness and personal control

Given the multitude of benefits associated with feeling a sense of personal control, researchers have focused on outlining methods by which an individual might increase his/her sense of control. In this section I will describe socio-cognitive mindfulness (also called "Langerian mindfulness"), a multifaceted concept that has been developed over 40 years of research (Langer, 1989). Specifically, I will describe its key features and how they may help individuals experience more control over the aging process and chronic pain experiences, which I will outline in Chapters 2 and 3, respectively.

Two ways of being: Mindful and mindless. In the 1970s, Langer and colleagues observed empirically how people are quick to recycle a previously-learned rule or formula, even when the context is no longer appropriate to use said rule or formula (e.g., Langer, Blank, & Chanowitz, 1978). These observations led to the theory that people spend the majority of their time in a "mindless" state (Chanowitz & Langer, 1981; Langer, 1989), which can be understood as operating on "automatic pilot." When one is mindless, one automatically applies old information or mode of thinking to the current context. In this automatic processing model, one searches for information that is hypothesis supporting. In contrast, when one is in a "mindful" state, he/she actively notices new things about the current situation and draws novel distinctions; he/she is sensitive to subtle changes in the context. Mindfulness as described by Langer is about considering alternative perspectives and being open to new possibilities (Langer, 1989; Langer & Moldoveanu, 2000).[1] According to this theory, mindfulness is the process of noticing something on purpose. For example, one might notice how something is different from how (s)he expected

[1] Note that we are not referring to "mindfulness" as it is often used in the Eastern tradition,

it, even if the deviation is quite subtle. In this active process of noticing, one opens up to different possibilities and avenues of choice.

Theoretically, approaching a situation mindfully should promote a sense of control by combating mindless beliefs i.e., acting without considering the current context. One way that mindfulness could promote a sense of control is by upending the limiting belief of stability in a changing world, especially when the perceived stability is related to negative symptoms. Someone in a mindful state would attend to the natural variability in the environment (Langer, 1989). According to this approach, the novelty-seeking aspect of mindfulness gives one a sense of control by enabling flexible problem-solving and making clear continual opportunities for choice. When someone is in a mindful state, they expect variability in the environment. Langer describes this process as attending to variability or "ATV" (Langer, 1989).

Attending to symptom variability. A large body of research demonstrates that people move through life mindlessly, that is, as though events were unchanging and context-independent (see Langer & Moldoveanu, 2000). This dominant orientation starkly contrasts against the biological reality of allostasis. Allostasis is the process by which the human body is in its healthiest state, rapidly sensing changes in the internal and external environment and adapting readily (McEwen & Wingfield, 2003). In line with the allostatic framework, studies from the past 40 years have shown that noticing novelty on purpose is associated with improved health and psychological well-being (for a review see Langer, 2009).

The idea of attending to variability is about challenging mindless beliefs, specifically the belief that something or someone is remaining stable over time. This rigid thought pattern is theorized to limit personal control.

Consider people with "chronic" health conditions who come to believe that they experience their symptoms *all the time*. When chronic health patients are taught to pay attention to how their symptoms vary over time, they can benefit in at least three ways. First, they experience a general sense of control over their illness by realizing that their symptoms are not present all the time. Second, they begin to notice patterns in their symptoms; namely, that certain contexts make their symptoms more or less severe. In noticing and analyzing these contexts, the individual can actually begin to control their symptoms by avoiding certain situations and actively searching others that minimize suffering and maximize wellbeing. Finally, actively noticing new things and seeing the limitless choices implied in any activity has been shown to be generally beneficial to health and wellbeing (Langer, 2009; Perlmuter & Langer, 1983)

As an example, consider someone with a diagnosis of chronic fatigue syndrome. Because the fatigue has been labeled as "chronic," the person may begin to buy into the belief that (s)he is tired "all the time". This limiting (and mindless) belief is likely an oversimplification, and it robs the person of control over the experience. Surely there are times of day when (s)he is less fatigued and times when (s)he is more fatigued. Teaching people to attend to variability can help provide relief in a number of ways. First, when they are asked to notice times throughout the day that they are more and less tired, they begin to question the pervasive control of the illness over their lives. Second, they can notice the circumstances under which they are more fatigued and alter their schedules accordingly. An individual may consistently notice more fatigue after meeting with a specific person. If possible, the individual can enact control by avoiding meeting with this person or meeting for a shorter period of time. Finally, noticing the nuances of the fatigue experience may spark curiosity about the nuances in the world, in general.

Just as Langer considers the construct of mindfulness as both a state and trait measure (Langer, 1989), one can also consider that people differ in the amount they attending to variability. As such, there are two lines of research in the field of sociocognitive mindfulness: one examining how trait levels of mindfulness predict wellbeing and another examining the effects of an attention to variability (ATV) training.

For example, both patients with amyotrophic lateral sclerosis and their caregivers who are more mindful have been shown to experience more positive wellbeing and quality of life, decreased rates of functional decline and less burnout (Pagnini et al., 2015; Pagnini, Phillips, Bosma, Reece, & Langer, 2016).

Two empirical studies recently applied the attention to variability paradigm in a training context (Delizonna, Williams, & Langer, 2009; Zilcha-Mano & Langer, 2016). Delizonna and colleagues found that people who were trained to pay attention to their heart rate over the course of a week had more control over it after one week than those who were trained to pay attention to the stability of their heart rate (Delizonna et al., 2009). The second study found that pregnant women who paid attention to the variability of their positive and negative physical symptoms and mood over the course of a few weeks demonstrated better mental health and more positive affect postpartum than those in the control groups (Zilcha-Mano & Langer, 2016). As of yet, there have not been any published studies investigating ATV training in those with chronic illness or aging, experiences which can both be characterized by strong prior beliefs about time-related expectations. In the case of chronic illness, one can have the belief that symptoms are present all the time. In the case of aging, one can have the belief of ongoing decline. I will investigate the effects of attending to variability on personal control beliefs and health outcomes (i.e., cognitive performance and experienced pain).

1.5 Two investigations of the "ATV Hypothesis"

One potential way to influence personal control that has not been investigated is teaching people to attend to variability in their symptoms. We investigated the attention to variability paradigm in two populations: older adults who believe they are experiencing age-related memory decline (Chapter 2) and patients suffering from chronic pain (Chapter 3). These populations relate in that they are both characterized by strong beliefs about the limitations their conditions confer. In the case of aging, decline is assumed as the norm (Fiske, Cuddy, Glick, & Xu, 2002). In the case of chronic pain, pain is believed by some patients to be present all the time. Because both aging and chronic pain experience are often perceived as externally controlled and inevitable, they are good candidates for investigating the attention to variability (ATV) paradigm and, more specifically, how it operates in populations with low internal perceptions of control.

Chapter 2. Successful aging, personal control, and mindfulness

2.1 Defining successful aging

The U.S. Bureau of the Census (2011) reported that between the years 2000 and 2010, the rate of growth for the nation's 65-and-older sector surpassed the growth rate of the entire population. Similarly, in the European Union, the ratio of people above 65 years old to people between 15 and 64 years old is projected to increase from 25.4% to 53.5% between 2008 and 2060 (European Commission, 2009).

As a result of this demographic shift, research has increasingly turned to maintaining well-being in later life, including investigations on how to preserve physical and cognitive functioning as well as psychological health (Cho, Martin, & Poon, 2014; J. W. Rowe & Kahn, 1997). This chapter will investigate the beliefs people hold about the aging process, the implications of these beliefs for perceived control, and a mechanism by which older people might increase perceptions of control over their memory performance, namely, learning to pay attention to how their memory performance is changing over time.

2.2 Beliefs about aging and personal control

At the same time that people believe they can control chance events, they also perceive the aging process as one of increased disability and uncontrollable decline (Fiske, Cuddy, Glick, & Xu, 2002; Langer, 1989). Associations between old age and ill-health--fostered by societal messages, negative labeling, and stigmatization of older adults--lead to expectations of decline and of incompetence among this age group, which cause them to forfeit control and lower self-esteem (Rodin & Langer, 1980).

The venerable qualities originally subsumed in the term "elderly" are largely overlooked in its colloquial use. In its original form, the term described a wise and respected individual of

advanced age; however, its contemporary use has come to ascribe it the same assumptions of instability and uncontrollability as labels of chronic illness and decline. Similar to labels of chronic illness, our society's labels for aging individuals have managed to foster implicit negative attitudes about older adults as being inflexible, incompetent, low in personal control, and susceptible to ill-health. Drastic increases in life expectancy over the past century, coinciding with a shift in leading causes of death from acute to chronic illness (Johnson, Hayes, Brown, Hoo, & Ethier, 2014), may have contributed to a view of aging and chronic illness as inextricably linked. While it is typically assumed that susceptibility to chronic illnesses and disabilities increases with age, contrary to expectations, poor health is not an inevitable consequence of aging (J. Rowe & Kahn, 1987; J. W. Rowe & Kahn, 1997). Moreover, scientists have come to understand aging through a biopsychosocial model (Rook, Charles, & Heckhausen, 2011), understanding that the process of aging is hugely affected by psychological, behavioral, and environmental factors within the individual's control.

One significant factor that leads to a relinquishing of personal control and to an illusion of incompetence are premature cognitive commitments (Chanowitz & Langer, 1981). Premature cognitive commitments form when we accept initial impressions or pieces of information at face value, without thinking critically about their context-dependent nature, and allow those initial impressions to settle and crystallize in our minds until similar signals from the world call up these impressions or information again (Langer, 1989). At this point, however, now later in time and in a much different context, we nevertheless respond to those initial impressions and information in the same way as we had the first time. That is, even though the previously-learned information does not dictate behavior in the current context in which it is now triggered, we still act according to the old information. Premature cognitive commitments therefore reflect a

mindless process in so far as previously-learned information is no longer available (or selected) for conscious processing and evaluation (Langer, 1989; Langer, Hatem, Joss, & Howell, 1989).

In the case of aging, we learn as children what it means to "be old." This information is learned free of context and is later unpacked just as it was initially learned for reference once people reach older age (Langer, 2009). The specific "facts" that Western children learn characterize the aging process as one of inevitable and largely uncontrollable decline. These attitudes are pervasive in Western society to such an extent that even young children espouse these attitudes; even before entering elementary school, children demonstrate negative stereotypes toward older adults (Isaacs & Bearison, 1986). Moreover, there is evidence to suggest that as a person ages these stereotypes become self-views (Rothermund, 2005). Not only do people explicitly stereotype older adults, but they also hold implicit stereotypes about this age group (Levy & Banaji, 2002).

The primary stereotypes held about older adults are that they are high in "warmth" dimensions (e.g., "kind"), but low in competence dimensions (e.g., "frail"; Cuddy, A.J.C. and Fiske, 2002; Fiske et al., 2002). While age-based stereotypes are multifaceted and include both positive and negative aspects (Cuddy, Fiske, & Glick, 2008), the negative aspects are generally more emphasized, with older adults generally stereotyped as forgetful, slow, timid, weak, and rigid (Nelson, 2004).

It is of little surprise that people of all ages hold implicit and explicit stereotypes of the older adults given how deeply they insinuate themselves into Western culture. This is reflected in and perpetuated by linguistic patterns. Specifically, a textual analysis spanning English material across a 200-year period of time demonstrated a linear trajectory of negative age-based stereotypes (Ng, Allore, Trentalange, Monin, & Levy, 2015). For example, negative societal

expectations about aging process are reflected in common expressions, including “senior moments,” which semantically links age and forgetfulness (Bonnesen & Burgess, 2004) and “over the hill,” a phrase with indicates that once one reaches a certain age, he or she will begin to decline

Pertinent to the current discussion of perceived control and successful aging, societal stereotypes of old age contribute to personal experiences of decreased perceived control in older adults. Specifically, expectations of aging as a process of increasing dependence on others can negatively affect older adults’ experience of self-efficacy and control (Langer, 2009). The language of aging and age-related cues dictate functioning as individuals’ identities crystallize around assumptions that then become self-fulfilling prophecies or situation-inferred losses of control.

Consistent with Langer's mind/body unity theory (see Langer, Chanowitz, Jacobs, Rhodes, Palmerino, & Thayer, 1990), the stereotype embodiment theory (Levy, 2009) describes how people age in accordance with their own stereotypes about older people. For example, individuals from cultures with predominantly strong negative beliefs about older people (i.e., those who grew up in the United States) were more likely to experience memory problems than those from cultures who do not hold the same negative beliefs (i.e., China and the American deaf community, Levy & Langer, 1994). These attitudes not only affect older adults’ memory abilities, but predicted longevity; survival analyses revealed that people with positive attitudes of aging lived about 7.5 years more than those who did not hold negative beliefs about the aging process (Levy, Slade, Kunkel, & Kasl, 2002).

2.3 Challenging the aging label

How might older adults loosen their premature cognitive commitment about the aging process? Mindfulness theory suggests that noticing new things about the environment (including the self) allows one to broaden one's fixed schemas (Langer, 1989). One's beliefs about the aging process are no exception.

Research has shown that having "young" grandparents while growing up was related to a longer life, suggesting that one's early schemas of "old" may affect longevity (Langer, Perlmuter, Chanowitz, & Rubin, 1988). This loosening of cognitive labels is considered an inherently mindful process (Langer, 1989).

Another avenue for changing attitudes is subliminal priming methods, which involves training a person to dissociate the concept of "old" and "bad" by teaching a new association, namely strengthening the "old-good" connection. Research has shown that this type of training over a few months significantly improves perceptions of control (Levy, Pilver, Chung, & Slade, 2014). If one has an especially strong and overlearned association of "old" and "bad", another method is to remove cues from the environment that they have come to associate with old age. This idea was demonstrated most powerfully by a study conducted in 1979, which warrants a detailed description. In this experiment (Langer, Chanowitz, Jacobs, Rhodes, Palmerino, & Thayer, 1990; Langer, 2009; Langer, 1989), Langer and colleagues tested the hypothesis that when older people bring their minds back to a more youthful period, their bodies will also become more youthful. To test this hypothesis, 70 year-old men lived together for five days in a house retrofitted with furniture and décor from 1959 (20 years before). Participants were instructed to live as though it were actually 1959. The researchers provided magazines, television programs, songs and movies that were popular just twenty years before. Participants were

instructed to talk about events that happened in 1959 as though they were current events and not to refer to anything that happened after that date (including personal experiences).

Older men who were randomly assigned to a control group also attended the retreat at the retrofitted house at a separate time, but these men were not asked to live as though it were 1959; instead, they were asked to reminisce about that time in their lives, surrounded by the same cues of the 1959. Because the retreat was novel and mindfulness inducing, participants in both the control and experimental groups improved significantly on many measures, which challenged the decline model of aging. Participants in both groups improved on measures of physical health including better hearing, stronger hand strength and increased appetites. Participants also improved on tasks testing figure memory ability. In regards to engagement, researchers observed that participants took the initiative to prepare their own meals and clean up after themselves, a marked from initial reports of dependence on caregivers. These results suggested that removing cues of age and inserting cues of youth affect one's perception of control and health.

Moreover, compared to those who were asked to reminisce about this period, those who "became" their younger selves improved more on measures of vision, joint flexibility, posture, manual dexterity, and digit-symbol substitution. Just by "being" their younger selves, the older adults in the experimental group were able to significantly improve their own health, even on measures that were thought to be irreversible. Moreover, at the end of the study participants looked significantly younger than at the study's start. This study suggested that age-related cues affected both physical and cognitive health in dramatic ways.

These findings were corroborated by evidence from Hsu, Chung, and Langer (2010), who examined the effects of age cues on health and longevity across five very different settings. One of the primary findings was that women who think they look younger after having their hair

colored or cut show a decrease in blood pressure and appear younger in photographs presented to blind raters. In the same study, the researchers discovered that clothing, unlike uniforms, can function as an age-related cue such that those who wear work uniforms have lower morbidity than those who earn the same amount of money and do not wear work uniforms. They also found that baldness cues old age; male participants who balded prematurely saw themselves as older, aged faster, and had an increased risk of getting prostate cancer and coronary heart disease compared to male counterparts who did not prematurely bald. Older mothers also demonstrated a longer life expectancy compared to women who bore children earlier in life, possibly due to their exposure to younger age-related cues. Lastly, Hsu et al. (2010) found that in domestic relationships involving partners of significantly-varying ages, younger spouses lived shorter lives while older spouses lived longer lives, presumably due to their exposures to older and younger age-related cues, respectively.

In the present study we utilized the attention to symptoms variability (ATV) paradigm in order loosen perceptions of decline. Specifically, we asked older adults with concerns about memory to notice the natural fluctuations in their memory performance throughout the day for six days using text message prompts sent to their cell phones. As with any ATV intervention, our design emphasizes that one's memory is not uniformly poor that fluctuations are a result of different environmental factors that are more controllable than the "aging" narrative. Ours is the first study to investigate how the ATV paradigm can be applied to beliefs about age-related decline.

Beliefs about memory ability and decline trajectories. One stereotype that is especially tied to the aging process is cognitive decline, particularly memory loss (e.g., Cuddy & Fiske, 2002). Both middle aged and older adults, alike, admit that they are concerned about their

own memory loss (Lachman, 2004). Memory complaints increase with age, concerning 41% of those aged 55-65 years and 52% of those aged 70-85 years (Commissaris, Ponds, & Jolles, 1998). In the case of those in middle age (40-59 years of age), these concerns are often unfounded, as those in this particular age demographic experience a peak for many cognitive abilities including verbal memory, vocabulary, inductive reasoning, and spatial orientation (Willis & Schaie, 1999). Two decades earlier Langer and colleagues (1979) demonstrated that older adults would remember what is important to them. Despite these developmental strengths enjoyed in middle age and ability of older adults to focus on what is important, a billion-dollar industry of preserving cognition has emerged, including online "brain games" (e.g., Lumosity.com), which endorse a "use it or lose it" approach to cognitive health. The popularity of these games seem to suggest that there is a market of consumers who do believe that something can be done to maintain cognition. However, there is much empirical evidence that older adults do not feel much control over their memory (e.g., Hultsch, Hertzog, Dixon, & Small, 1998). For example, they are much less likely than younger adults to attribute memory successes to controllable factors (e.g., strategy) than they are to attribute them to uncontrollable factors (e.g., ability or genes; Blatt-Eisengart & Lachman, 2004).

These beliefs have real-world consequences for future health, particularly for cognitive health. Studies have shown that the self-perception of memory decline, as well as stereotypic beliefs of aging, are strong predictors of actual memory decline (Cook & Marsiske, 2006; Zelinski, Gilewski, & Thompson, 1980). Moreover, perceived memory decline was implicated in subsequent global cerebral metabolic decline (Ercoli et al., 2006). People who held more negative age stereotypes at baseline showed significantly steeper loss of hippocampal volume and more accumulation of neurofrillary tangles and amyloid plaques, both of which are

associated with Alzheimer's Disease (Levy et al., 2016). This effect held when controlling for measures of baseline health. Related to beliefs about decline trajectories are beliefs about one's memory ability, also called memory self-efficacy (or MSE). Beliefs of memory efficacy have been shown to be positively correlated with performance on episodic memory tasks (Berry & West, 1993) and have also been shown to account for some age-related variance in memory performance (Desrichard & Köpetz, 2005). Even so, the relationship between memory efficacy beliefs and memory performance is a complex one. Two recent meta-analysis found a low, but statistically significant correlation between memory self-efficacy beliefs and memory performance where $r = .15$ (Beaudoin & Desrichard, 2011) and $r = .06$ (Crumley, Stetler, & Horhota, 2014). One interesting nuance of the Beaudoin and Desrichard (2011) meta-analysis was that memory performance was more positively correlated to concurrent memory efficacy beliefs (i.e., how an individual feels they are performing on a certain task) than to overall memory efficacy beliefs. Indeed, researchers have found that older adults are often inaccurate when asked to rate their memory ability and how it had changed over time (Rickenbach, Agrigoroaei, & Lachman, 2015).

Given the importance of these beliefs, many researchers have investigated ways to improve memory self-efficacy. On the whole, subjective memory seems much more difficult to manipulate than objective memory performance in older adults (Lachman, 2004). One avenue that researchers have used to improve memory self-efficacy beliefs is by teaching memory strategies. For example, Lachman, Andreoletti, and Pearman (2006) found that teaching older adults to categorize items in an episodic memory task led to increased control beliefs over their memory. As mentioned in Chapter 1, Lachman and colleagues (1992) found that cognitive restructuring about memory beliefs (paired with memory strategy training) improved both

memory efficacy beliefs and cognitive ability. Indeed, a meta-analysis from Floyd and Scogin (1997) confirmed that the most effective method by which researchers could improve memory efficacy were protocols that combined mnemonic strategy training and attempts to modify expectancies/beliefs about memory ability.

Intervention modality. In the past, these training studies have relied on in-person sessions, which take place over the course of many weeks (Floyd & Scogin, 1997; Lachman et al., 1992). One issue with this approach is scalability. Namely, it would be increasingly difficult to widely offer this type of training to those who are interested in it using an in-person approach. Others have found that using text-message based interventions can be a good strategy for incorporating a population that would not normally have access to an in-person session: namely, those from a rural background (Mahmud, Rodriguez, & Nesbit, 2010). Another issue with the typical session-based approach is that it does not necessarily prompt participants to incorporate the intervention into their everyday lives. For example, an intervention that asks participants to generate positive statements that could replace negative cognitions about memory performance, does not offer participants the experience of noticing these cognitions in "real time." Given the increased trend in favor of technology-based interventions in many populations including among older adults (Bercovitz & Pagnini, 2016), we decided to use text messaging in order to deliver a mindful attention to symptom variability training.

2.4 ATV pilot study

We conducted a brief pilot study in order to evaluate a physical workbook that was designed to prompt participants to notice the patterns in their memory throughout the day. For this pilot study, we recruited six older adults from the greater Boston Area to complete our ATV workbook exercises. One individual did not feel that they had enough time to commit to the

experiment so they quit the study after the first session, leaving us with 5 individuals (N = 5, M_{age}= 68.4, age range: 60-74; 3 males).

We gave participants a physical workbook that they were asked to fill out consistently at breakfast, lunch, and dinner for 12 days. In this workbook they were asked to write down all the things that they remembered and forgot since the last time they wrote in the journal. Every three days, they were asked to tally up the total instances of forgetting and remembering.

Procedure. Participants were recruited from a list of individuals who had taken part in memory studies with the lab before. Participants were screened via telephone and were invited to participate if they met the following inclusion/exclusion criteria: no indication of cognitive impairment (score > 8 on the Short Portable Mental Status Questionnaire), no history of stroke, brain injury, other neurological disorders, or depression. Participants were also required to respond that they were fluent in English Participants came into the lab individually for their first measurement session and we introduced the workbook exercises. We instructed participants to begin their workbook exercises the following day. After six days of at-home activities, participants came into the lab for testing. On Day 13, participants returned to the lab for final testing. Survey data were collected on the computer via the Qualtrics.com platform. We compensated participants $15 to help cover travel expenses to and from the lab.

Outcomes. While our primary goal for this pilot study was to gather qualitative feedback about our ATV intervention workbook, we also measured subjective memory performance and memory concern using the Everyday Memory Questionnaire-Revised (Royle & Lincoln, 2008). We found that subjective memory performance increased after one week for 4 out of the 5 individuals. After six more days, all 4 of these individuals reported a decrease in their subjective memory performance from the midweek session. After six days of the intervention, 3 of the 5

individuals in the ATV group reported less stress over their memory lapses. After six more days of the intervention, reports of memory concern increased again for 2 out of the 3 individuals, with the third experiencing no change in concern. See Figures 1.1 and 1.2 below.

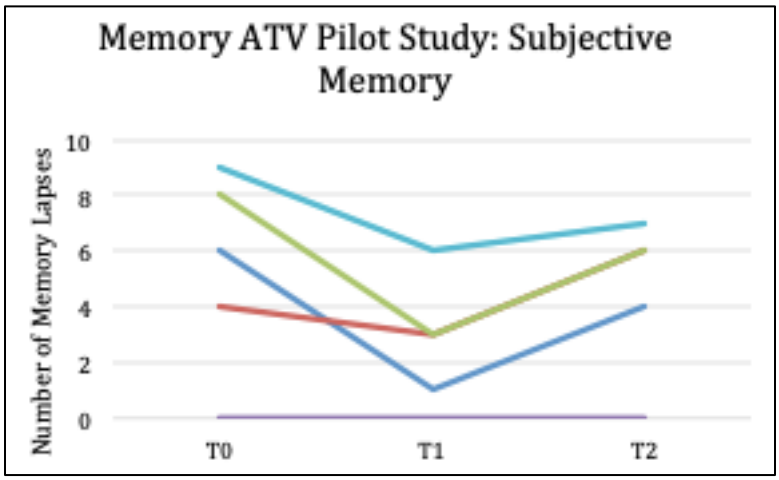

Figure 1.0. Memory Pilot Study. Number of "yes" responses on the Everyday Memory Questionnaire. More "yes" responses indicate lower subjective memory (N=5). We measured subjective memory performance at three time-points with 12 days of at-home activities (attention to variability in memory) assigned between T0 and T2.

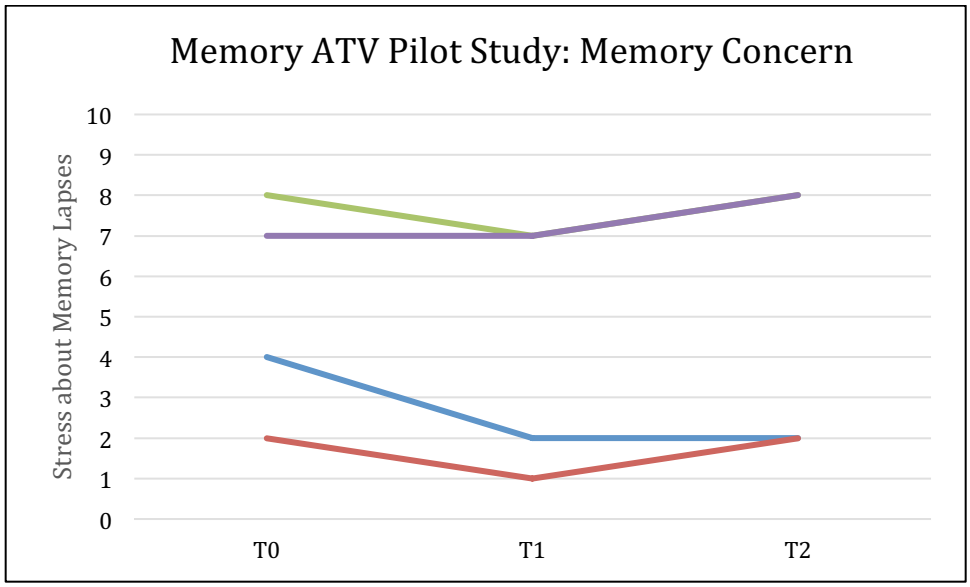

Figure 1.1. Responses of how stressful the memory lapses described in Everyday Memory Questionnaire with 0 indicating "not at all stressful" and 10 indicating "very stressful" (N = 4). We measured stress about memory performance at three time-points with no activities assigned in the 12 days between T0 and T2. One individual did not respond to the question since they did not indicate any memory lapses.

Qualitative feedback. Our main instruction to those in the study was to make note of the things they remembered and forgot since the last time they wrote in their notebooks. In the final survey, four out of the five individuals indicated that they felt that a strength of the study was that it made them more aware of their memory.

We found that while many people consistently wrote in their study notebook, they expressed uncertainty about how many items they should write about. Additionally, many participants from this pilot study reported that they found it very difficult to write about specific things they *remembered* to do and ended up just writing a list of things they accomplished

during the time period (e.g., washed the dishes, changed the laundry). Participants tended to focus on the things they were forgetting, occurrences that were most salient to them (e.g., "good specifying forgets [sic], but it's harder to be consistent about what remembers to include"). When asked about the limitations of the exercises, two of the five participants commented that they felt limited by us asking at the same time each day. With this feedback in mind, we decided to ask participants in our text-message study to focus on their memory performance in the past 30 minutes to encourage a less biased reflection. We also decided to ask participants about specific types of forgetting that they experienced during the last 30 minutes (adapted from Royle and Lincoln's Everyday Memory Questionnaire, 2008).

We found our approach of teaching the participants about ATV left much room for improvement. Specifically, we relied on the participants to notice that their memory was changing throughout the day, but did not explicitly ask them to compare timepoints across the intervention. In addition, participants selected instances that were salient to them, but we felt that this did not aid in our goal of showing them how their memory changes throughout the whole day. Namely, we did not give them a good method of sampling across their day in an unbiased manner.

Take-aways. We had two primary take-aways from the pilot study. The first conclusion was that we wanted to remove the ambiguity and bias from the sampling process and give participants a more systematic approach to sample the variability in their memory performance. Therefore, we reasoned that text messages could prompt participants to make comparisons across disparate points in time, which would be more effective at teaching participants about variability in their memory performance across the day.

Our pilot study also informed our decision about the length our text-message-based intervention. Specifically, we found that it was most convenient for participants to schedule the first and second sessions one week apart. Therefore, to make the first and session sessions one week apart, the intervention must occur in the time between these sessions. Another decision we had to make was whether or not to continue the text messages for two weeks. Our pilot study included 12 days of journaling with an in-person session in the middle to give the participants the chance to reflect on general patterns and also to ask any clarifying questions to the experimenter. Any improvements we did observe came from the first to the second session and did not continue to improve as a result of the second week of journaling. Therefore, we decided to make our intervention six days in length, which was in line with the ATV study investigating heart-rate variability (Delizonna et al., 2009).

The goal of the research presented below was to investigate the effects of a text-message-based intervention, which prompted participants to reflect on natural variability of their memory processes.

2.5 Research questions and hypotheses for study 1

Given the large body of evidence demonstrating the importance of maintaining perceptions of control (see Chapter 1), it is essential to investigate ways in which older adults can maintain high internal control beliefs, particularly with regard to memory. Specifically, we investigated the attention to variability (ATV) paradigm over the course of a week with older adults who view their forgetting behavior as problematic. We prompted older adults to focus on the variability in their memory ability, with the overarching goal of challenge the idea of steady age-related decline. This ATV training occurred over six days, sandwiched by two assessment sessions, both of which included online and phone components. In addition to investigating the

effects of this mindful attention training on memory control beliefs, we also assessed changes in perceptions of memory ability and performance on cognitive tests. Our primary hypotheses for Study 1 were:

1. Older adults who are prompted to attend to the variability in their memory performances will demonstrate increases in positive memory efficacy beliefs (as measured by the Memory Controllability Inventory). We hypothesize that this effect will not occur in the comparison groups.
2. Older adults who are prompted to attend to the variability in their memory performances will demonstrate a change in their subjective memory performance, such that they will indicate fewer memory lapses over the past 24 hours at T1 than T0 (i.e., Question #1 on Everyday Memory Questionnaire). We hypothesize that this effect will not occur in the comparison groups.
3. Older adults who are prompted to attend to the variability in their memory performances will report less stress about their memory failures at T1 than at T0. We hypothesize that this effect will not occur in the comparison groups.
4. Older adults who attend to the variability in these abilities will demonstrate improved memory scores, while those in the comparison groups will not.

Our secondary hypotheses were:

1. There will be a positive relationship between positive memory control beliefs and scores on the Langer Mindfulness Scale.

2.6 Methodology for study 1

Participants

Sample size. Sample size was determined in order to have enough power to detect an effect given the analysis, a one-way ANCOVA. Specifying this test with three groups, statistical power =.80, $\alpha = .05$, and expecting a medium effect size, our power analysis suggested a final sample size of 52 per group (Total *N*= 156; Cohen J., 1992). This effect size is based on Delizonna and colleagues' study using the ATV paradigm (Delizonna et al., 2009), which reported an ETA = .23. Delizonna et al. (2009) also reported a 25% data attrition rate, which indicated initially that we should aim to recruit 65 individuals per group (Total *N* = 195 individuals). After 100 participants enrolled in the study, we checked the attrition rate (including technical errors), which was 10% at that point. Therefore, I decided to conservatively account for a possible 15% attrition and enroll at least 180 individuals.

Recruitment. A total of 188 participants (ages 65-80) were recruited from around the United States using a a Facebook.com advertising campaign (N = 107), electronic newsletters and bulletin boards associated with Osher Lifelong Learning Institutes (N = 24), an older adult database created from previous lab studies (N = 17), a Craigslist ad (N = 3), and referrals from friends and family (N = 4). Thirty-three individuals did not remember or did not report the mode of recruitment. These advertisements began with "Do you have "senior moments" that concern you?" in order to recruit those with memory concerns (see below a sample advertisement). These advertisements included a link to a 5-minute online prescreening survey and the researchers' contact information. If participants met the first round of inclusion criteria, they were prompted to enter an email address and phone number so that we could contact them. The majority of people completed the online prescreening survey (N= 72), while some completed the full prescreening process over the phone (N =16).

Figure 1.2. Sample Online Advertisement for the Memory Study.

Inclusion and exclusion criteria. Inclusion criteria for participants included a) 65-80 years of age; b) fluency in the English language (An affirmative response to "Are you fluent in English?"), c) expressed concern about one's memory (An affirmative response to "Would you say you are at all concerned about your memory?"). Exclusion criteria included: a) the presence of cognitive impairment (score of < 8 on the Short Portable Mental Status Questionnaire); b) the presence of any medical conditions that affect cognitive ability, such as stroke, acquired brain injury, other neurological disorders or illnesses, or untreated hypertension. Participants were also excluded from the final analysis if they did not complete 2/3 of questions from any of the following: Survey 1, Survey 2, and our text message prompts. Our final attrition was 32 individuals out of 186 enrolled (17% attrition; see Table 1.0 below). One hundred fifty-six individuals were included in the final analysis (M_{age} = 69.85, *SD* = 3.80; $M_{Education}$ = 17.30, *SD*

=2.65; 142 females). The characteristics of the final sample are also included in Table 1.1 just below.

Table 1.0. Attrition of memory study participants.

	Total	**Usable Data**
Enrolled	188	
Quit	4	184
Did not complete 2/3 of Survey 1	5	179
Technical difficulties	4	175
Did not complete 2/3 of text messages	13	162
Did not complete 2/3 of Survey 2	6	156

Table 1.1 Participant characteristics of memory study.

		Total
Gender		
	Male	13
	Female	142
	Other	1
Education		
	Less than high school	1
	High school graduate	3
	Some college, but no degree	12
	Bachelor's degree	16
	Associate's degree	43
	Master's degree	61
	Doctorate	12
	Professional (JD, MD)	8
Marital Status		
	Single	21
	Married	69
	Widowed	18
	Separated	2
	Divorced	37
	Civil Union	3

Table 1.1. Participant characteristics of memory study (Continued).

	Other	6
Income per year		
	$10,000 to $19,999	10
	$20,000 to $29,999	14
	$30,000 to $39,999	22
	$40,000 to $49,999	16
	$50,000 to $59,999	14
	$60,000 to $69,999	11
	$70,000 to $79,999	8
	$80,000 to $89,999	8
	$90,000 to $99,999	10
	$100,000 to $149,999	22
	$150,000 or more	11
	Prefer not to answer	9
Employment Status		
	Working (Paid employee)	28
	Working (Self-employed)	9
	Not working (Temporary layoff from job)	1
	Not working (Looking for	3

	work)	
	Not working (Retired)	108
	Not working (Disabled)	4
	Not working (Other)	0
	Prefer not to answer	0
Race		
	White/Caucasian	148
	Black/African American	2
	Other	1
	Multiracial	2
	Asian	3
Identifies as Religious		
	Yes	71
	No	77
	Prefer not to answer	8
Region of Residence		
	Northeast	53
	South	47
	Midwest	31
	West	25

Measures

Prescreening Measures

Short Portable Mental Status Questionnaire (SPMSQ-T; **Roccaforte, Burke, Bayer, & Wengel, 1994).** Based on a test designed for in-person administration (Pfeiffer, 1975), the 10-item SPMSQ-T is a measure designed to screen for cognitive impairment over the telephone. The test is scored out of a total possible of 10 points, and includes questions designed to probe diverse cognitive abilities including short-term memory, long-term memory, orientation to surroundings, information about current events, and counting backwards. A score of 8-10 indicates no cognitive impairment. A score below 8 indicates the presence of a cognitive impairment, with a score of 6 or 7 indicating mild cognitive impairment, a score of 3-5 indicating moderate cognitive impairment, and a score of 0-2 indicating severe cognitive impairment. The SPMSQ administered by telephone has been found to offer modest accuracy distinguishing between those with cognitive impairment and those without cognitive impairment with a reported sensitivity of .74 and specificity of .79 (Roccaforte et al., 1994).

Primary outcome measures

Everyday Memory Questionnaire-Revised (EMQ-R; Royle & Lincoln, 2008). This 13-item self-report scale measures subjective memory performance. Namely, respondents are asked to indicate whether or not they had experienced certain memory failures within the past 24 hours (e.g., “Did you find that a word was "on the tip of your tongue" - you knew what it was but could not quite find it?). Following the 13 yes/no questions about one’s memory functioning, participants are asked to rate how stressful these failures are on a scale of 0-10 with 0 indicating “not at all stressful” to 10 indicating “very stressful.” The final question asks the participant to compare their memory functioning that day compared to other days (“much worse than usual, a

little worse than usual, same as usual, somewhat better than usual, much better than usual"). This 13-item version was shortened from the original 28-item version (Sunderland, Watts, Baddeley, & Harris, 1986). Analysis of the revised version demonstrated two main factors: Attentional tracking and Retrieval. The EMQ-R has demonstrated strong internal reliability (Royle & Lincoln, 2008).

***Memory Controllability Inventory (MCI; Lachman, Bandura, Weaver, & Elliott, 1995*).** The Memory Controllability Inventory is a 19-item Likert scale with questions about one's memory. Participants rate each statement from 1 (*strongly disagree*) to 7 (*strongly agree*). The MCI includes six subscales, including: Present Ability (e.g., "I can remember the things I need to."), Potential Improvement (e.g., "I can find ways to improve my memory"), Effort Utility (e.g., "If I work at it, I can improve my memory."), Inevitable Decrement (e.g., "There's not much I can do to keep my memory from going downhill."), Independence (e.g., "As I get older I won't have to rely on others to remember things for me."), and Alzheimer's Likelihood (e.g., I think there's a good chance I will get Alzheimer's disease"). On all the subscales except Alzheimer's Likelihood and Inevitable Decrement, higher scores indicate higher levels of perceived personal control over one's memory. The authors reported alpha reliability coefficients from three samples ("Present Ability" alpha = .58-.70, "Potential Improvement" alpha = .62-.70, "Effort Utility" alpha = .65-.73, "Inevitable Decrement" alpha = .58-.77, "Independence" alpha = .49- .68, "Alzheimer's Likelihood" alpha = .65-.73). Of the 19 items, 5 are reverse scored.

***Brief Test of Adult Cognition by Telephone with Stop-and-Go Switch Task (BTACT;* Tun & Lachman, 2006).** The BTACT is a neuropsychological battery based off well-known laboratory tasks and modified versions of well-established psychometric tests. The BTACT, which is proctored over the phone, is designed to be sensitive to performance on a range of

cognitive abilities in older adults without cognitive impairments including: episodic verbal memory (both immediate and delayed list recall of 15 unrelated words of the Rey Auditory-Verbal Learning Test, Rey, 1964), working memory span (backwards digit span, Wechsler, 1997) and language verbal fluency. We also included the optional Stop-and-Go switch task to test task-switching ability/inhibitory control. Two versions of the test (Form A and Form B) are available for repeated measurement. This test has demonstrated good construct validity and test-retest reliability (Lachman, Agrigoroaei, Tun, & Weaver, 2014). Moreover, the assessment's authors found no difference in performance between individuals who took the test over the phone vs. in person (Tun & Lachman, 2006).

Secondary outcome measures

Langer Mindfulness Scale-14 Item (LMS-14; Pirson, Langer, Bodner, & Zilcha, 2012). We assessed trait mindfulness using the Langer Mindfulness Scale (LMS-14), a 14-item Likert scale (1= *Strongly disagree* to 7 = *Strongly agree*) which includes three factors: novelty seeking, novelty producing, and engagement, and good psychometric properties.

***Geriatric Depression Inventory - Short Form (GDI-sf; Sheikh & Yesavage, 1986*).** This scale is comprised of 15 yes/no questions and is typically used to screen for depression in older adults. The GDI-sf is an abridged version of the original 30-question assessment by the same authors, shortened with the goal of reducing participant response burden (Yesavage et al., 1983). A score of 5 (or higher) out of 15 indicates probable mild depression. The short form was found to be highly correlated with the long version (r = .89) with similarly high rates of sensitivity (Lesher & Berryhill, 1994). The GDS-sf has good validity in both out-patient and in-patient clinical populations, but not with patients with cognitive impairment (Herrmann et al., 1996; Lesher & Berryhill, 1994).

Program adherence. As a measure of program adherence, we calculated the proportion of text messages participants responded to out of the total 12 (i.e., 2 messages per day for 6 days). Participants were only included in the final analysis if they completed two-thirds of these prompts. The mean average number of scheduled text messages completed in our final sample was 11.01 (*SD* = 1.46).

Procedure

Prescreening. In order to determine eligibility, we screened interested parties in two parts. The first part was composed of questions regarding personal demographics, health histories, and attitudes toward memory. The second part was a cognitive assessment to assess possible cognitive impairment. Some people completed both parts over the phone (N = 16), while the majority completed the first part via an online survey delivered via the Qualtrics.com website platform and the second part over the phone.

Prescreening – Part 1. Potential participants completed the first phase of the prescreening, either on the phone, or via an online prescreening survey. This part of the prescreening determined whether participants met the following requirements: age (65-80 years), English fluency, owning a smartphone, concern with memory (an affirmative response to "Would you say you are at all concerned about your memory?"), no untreated hypertension, and no history of conditions that affect cognitive ability including stroke, acquired brain inquiry, neurological disorders and illness. Participants were also asked two more questions during this stage, though the responses did not have bearing on eligibility. These questions assessed whether they had noticed memory decline over the past few years (yes/no) and their level of concern with the memory decline ("On a scale of 1-5, how concerned are you about memory decline with 1 being "not concerned at all" and 5 being "very concerned".)

Prescreening – Part 2. The second phase of the prescreening consisted of a cognitive assessment over the phone, including the Short Portable Mental Status Questionnaire (SPMSQ, Pfeiffer, 1975) and some sections of the Brief Assessment of Adult Cognition by Telephone (BTACT, Tun & Lachman, 2006). Specifically, participants were tested on word list recall (immediate and delayed), digit span, verbal fluency, and inhibitory control. Participants were randomly assigned to either Form A or Form B of the BTACT. Only performance on the SPMSQ was used to determine eligibility (with a score of 8 or above ruling out cognitive impairment).

Compensation. In exchange for participating, participants received a $15 gift card code to Amazon.com. In addition, they received information about techniques to stay cognitively active, which was published by the Global Council on Brain Health (2017).

Random assignment. Participants were randomly assigned to one of three groups using random.org, which generates random numbers using atmospheric noise.

Baseline Measurement (Session 1). The first study survey was sent over email immediately after the cognitive assessment. This survey was delivered using an active link that directed users to a survey delivered on the Qualtrics.com platform. To start the survey, participants indicated that they had read and agreed to the terms in the informed consent. This baseline survey included the following items: Positive and Negative Affective Schedule (PANAS), Sunderland Everyday Memory, Memory Controllability Inventory, Multifactorial Memory Questionnaire, subjective age ratings, the Langer Mindfulness Scale (14-item version), questions about perceptions of health and quality of life, the Image of Aging Scale, the Geriatric Depression Scale (Short Form), and questions about demographics.

Experimental conditions. The three experimental conditions differed in the delivery schedule and content of ATV mindfulness instructions. All participants were asked to respond to two messages per day for six days. The High Mindfulness Memory group (Condition 1, N = 49) was designed to encourage participants to notice how their memory performance was fluctuating over the course of the week. The Low Mindfulness Memory group (Condition 2, N= 52) was designed to encourage participants to notice their memory performance over the week, highlighting the stability instead of the fluctuation. The General Mindfulness group (Condition 3, N = 55) was designed to make participants generally aware of their present experience, without attending to memory-related cues. The differences are noted below, as well as in Figure 1.3 just below the descriptions.

Condition 1 ("High Mindfulness Memory" group). For six consecutive days, we prompted participants in this condition to reflect on their memory twice per day (once in the morning and once in the late afternoon/early evening). The contact schedule was created separately for each participant using a random number generator with the parameters that the first message should be sent to the participant between 9am and noon and the second sent between noon and 8pm. Each communication asked participants to a) describe the activity they had been doing over the past 30 minutes, b) rate their memory performance during the last 30 minutes using a sliding scale (with 0 indicating *Poor* and 100 indicating *Excellen*t), c) check a box next to all the types of memory lapses/instances of forgetfulness they had experienced in the past 30 minutes (out of the 10 listed in the Everyday Memory Questionnaire), d) compare their memory performance to the last time we asked them using a sliding scale with -10 indicating

Much Worse, and 10 indicating *Much Better* [2] and e) describe any factors they believed may have accounted for any differences in memory performance. In addition, this group was instructed each morning at 9am to be attentive to how their memory performance changed throughout the day and to ask oneself what might account for these changes, though we did not require any response (see the text below):

"Throughout the day, pay attention to the natural fluctuations in your memory performance. Pay attention to the effects these changes have on you and your behaviors and interactions with others throughout the day. Most importantly, notice when your memory is better/worse and ask oneself why this may be (e.g., sleep, mood, distractions?) Notice three ways your memory is different from last time you checked."

Condition 2 ("General Mindfulness" group). Just like those in Condition 1, participants in Condition 2 were sent two text messages per day. Instead of receiving the messages on a random schedule, they received messages every day at the same times (i.e., one at 9am and one at 8pm) to discourage noticing fluctuation throughout the day. Those in this group were asked to reflect on the activity they had been engaged in over the past 30 minutes. They were not asked about their memory performance, at all.

Condition 3 ("Low Mindfulness Memory" group). Participants in this condition received daily prompts asking them to report on their memory performance over the last 30 minutes, just as those in Condition 1 did. Unlike those in Condition 1, those in the Low Mindfulness Memory group were only prompted to report on their memory performance in the morning at 9am. Also unlike those in Condition 1, participants in Condition 3 were not asked to reflect on how their

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[2] Note that this question did not appear if this was the first time we were texting the participant.

memory was fluctuating. Finally, participants in Condition 3 were also texted in the evening at 8pm, but this text message did not pertain to memory. This evening message prompted them to reflect on the activity they had been engaged in over the past 30 minutes. The rationale for including this evening text message prompt was to ensure that all groups received two text-message prompts per day. We thought that prompting them about their memory twice per day might encourage them to notice fluctuation in their memory performance, which we did not want.

Table 1.3. Differences in scheduling among the three conditions in memory study.

	General Mindfulness	**Low Mindfulness-Memory**	**High Mindfulness Memory**
2 daily text messages prompts?	Yes	Yes	Yes
Schedule of text messages	Fixed- 9am and 8pm	Fixed- 9am and 8pm	Random - morning (9am-noon) and evening (noon-8pm)

Table 1.4. Differences in scheduling among the three conditions in memory study.

	General Mindfulness	**Low Mindfulness Memory**	**High Mindfulness Memory**
Question about activities in last 30 minutes?	Yes	Yes	Yes
Questions about memory performance in last 30 minutes?	No	Yes	Yes
Question about how memory different from last time point?	No	No	Yes
Morning reminder to notice fluctuation in memory and consider underlying patterns?	No	No	Yes

Session 2 (Final Measurement). Participants were sent a final survey the day after their text messages ended. This final survey included the Sunderland Everyday Memory Questionnaire and the Memory Controllability Inventory.

Follow-up call. After the final survey, participants completed a 15-minute cognitive assessment via phone. Specifically, participants completed the form of the BTACT that they did not complete during the prescreening call (i.e., if they completed Form A in the first call, they would complete Form B in the follow-up call). The experimenter was always blind to the condition of the participant. In most cases (all except 2), the experimenter who proctored the final assessment session was also the person who conducted the prescreening call.

Debriefing. After the follow-up call, we sent participants a debriefing form via email explaining our study hypotheses, as well as an Amazon.com giftcard code for $15 and the handout from the Global Council on Brain Health (2017) entitled, "Engage Your Brain: GCBH Recommendations on Cognitively Stimulating Activities."

Data analysis. In order to determine the effects of our interventions on our dependent variables of interest, we first conducted a series of one-way ANCOVAs, inserting the baseline scores of each dependent variable as covariates. Before running these tests, we checked that statistical assumptions of the one-way ANCOVA were met for each of our dependent variables, as follows:

1. First, we checked for the homogeneity of regression means, separately for each dependent measure of interest, by inspecting the Condition x Baseline term of the ANCOVA analyses. We found that each of our measures satisfied this assumption (see Appendix A).

2. Second, we checked to make sure the data satisfied the assumption of homogeneity of variances across the experimental conditions by using Levene's Test of Equality of Error Variances. All measures except the Everyday Memory Questionnaire's "Stress about Memory Lapses" met this assumption (see Appendix A). In the case of the EMQ's question about stress, we utilized a reciprocal transformation. Figure 2.9 shows that the error variances were equally distributed after this transformation.
3. Third, we checked for outliers via visual inspection of the boxplots. Outliers were defined as those with standardized residuals with *z*-scores above or below 3. We found no outliers matching this definition in any of our dependent variables (see Appendix A).

For the Brief Test of Adult Cognition by Telephone (which is composed of many subtests), we conducted a Multivariate Analysis of Analysis of Variance (MANOVA), after verifying that we had satisfied the statistical assumptions, including:

1. The model includes two or more dependent variables that are measured at the continuous level;
2. The model includes one independent variable that consists of two categorical or more categorical, independent groups;
3. Independence of observations;
4. No multicollinearity (Appendix A);
5. Homogeneity of variance (see Appendix A[3])

[3] Note that the follow-up test for the reverse trials of the switch task cannot be accurately interpreted because the data did not meet the assumption of homogeneity of variance.

Given our data were not amenable to repeated measures ANOVAs (as we tested participants at only two time points), we decided to further investigate the difference between baseline and follow-up sessions by conducting a series of paired-sample t-tests, separately for each of the three study conditions. Given concerns about multiple comparisons and increased chances of a Type I Error, we applied a Bonferroni correction to these analyses, dividing the significance value (.05) by the number of tests performed (3) for a more conservative significance value of .017. In the cases of the High Mindfulness Memory group, we had a priori predictions about the direction of the effect, so our significance value was set to .1, and adjusted to .033 with the Bonferroni correction. Each of the dependent variables met the statistical assumptions of this test.

2.7 Results of study 1

In this section, we begin with a summary of the most notable findings, and then describe the results in detail for our four separate research questions, which investigated the effects of the interventions on 1) memory control beliefs, 2) subjective memory performance, 3) stress about subjective memory performance, and 4) actual memory performance.

Summary of results. As predicted, we found positive effects of the ATV intervention, with the High Mindfulness Memory group reporting significantly fewer lapses in their memory after the intervention ($p = <.001$), along with increased control over their memory. Specifically, those in the High Mindfulness Memory group became more likely to feel control over their present memory abilities ($p = .04$) and potential improvement ($p = .052$) after the intervention.

On the other hand, we found that those who were asked to pay attention to their memory and not the fluctuation (the "Low Mindfulness Memory" group) demonstrated declines in

reported beliefs about memory controllability including: decreased beliefs in the utility of efforts to improve memory ability (p = .013), decreased beliefs about control over their independence (p = .06), increased beliefs about memory decline being inevitable (p = .06), and increased beliefs about the likelihood of developing Alzheimer's Disease (p = .06). At the same time, this group also evidenced decreased stress about memory lapses (p =.001).

We found that noticing the activities they were engaged in (the task of the "General Mindfulness" group) positively affected the participants. Specifically, participants in this group became more likely to feel control over their present memory abilities (p = .043) and less likely to report memory lapses after the intervention (p =.013).

Finally, we found significant relationships between trait mindfulness and control beliefs about memory. We discovered a positive relationship between trait mindfulness and the following variables: Present Ability (r = .39, p < .001), Potential Improvement (r = .29, p < .001), Effort Utility (r = .23, p =.005), and Independence (r = .20, p = .012). We also discovered the predicted negative relationship between trait mindfulness and the following negative beliefs about memory controllability: Inevitable Decrement (r = -.27, p = .001) and Alzheimer's Likelihood (r = -.21, p = .01). See below for the full analyses, parsed by research question. For simplicity, the significant findings are presented below and the rest are included in Appendix A.

Demographic variables

First we tested to ensure that the groups did not significantly differ on the demographic variables of age, education (number of years), Geriatric Depression Scale (short form) and Langer Mindfulness Scale. The groups did not differ on these measures (See Appendix A for a full description of the analyses).

Research question #1: Control beliefs

Our first research question of interest was: Does paying attention to the variability in memory performance positively affect how much control someone feels they have over their memory?

To answer this question, we conducted an ANCOVA for each of the subscales of the Memory Controllability Inventory (MCI) that indicate positive attitudes towards memory controllability (Present Ability, Potential Improvement, Effort Utility and Independence), along with negative attitudes towards memory controllability (Inevitable Decrement and Alzheimer's Likelihood). We followed up the ANOVAs with a series of paired-sample t-tests.

MCI-Present Ability. Since the variances of these groups were not homogenous at baseline on this measure as determined by Levene's test, (F (2,153) = 4.91, p <.001), we conducted a Welch's F-test to determine that there were no significant differences among the three group means on "Present Ability" at baseline, *Welch's* $F(2, 100.50) = .329$, $p = .69$ (Appendix A).

A one-way ANCOVA revealed the following: As we expected, the covariate ("Present Ability" scores at T0) was significantly related to the final "Present Ability" scores, ($F(1,152) = 233.10$, $p < .001$, partial $\eta^2 = .61$; see Appendix A). After adjusting for pre-intervention scores of "Present Ability", there was not a statistically significant difference in post-intervention scores of "Present Ability" among the three conditions, $F(2, 152) = 2.112$, $p = .247$, partial $\eta^2 = .018$. See below for the Estimated Marginal Means of the three conditions at T1.

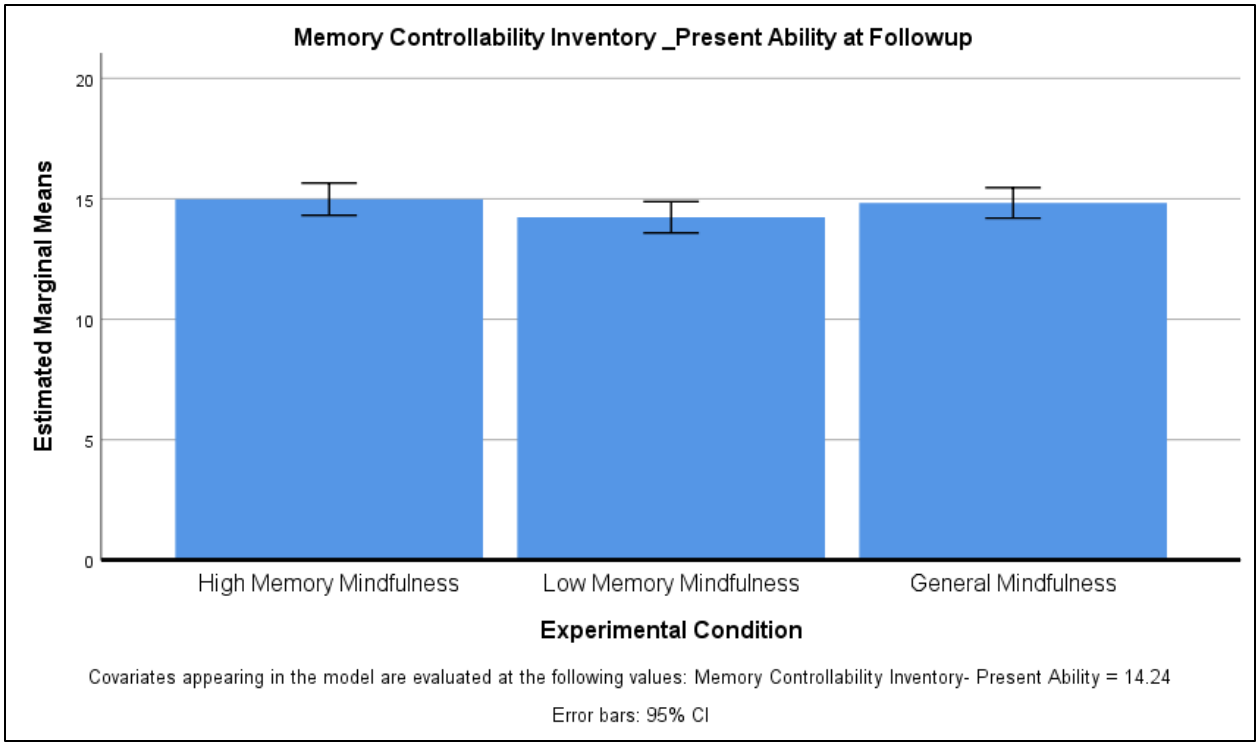

Figure 1.0. Estimated Marginal Means for "Present Ability" at T1 with error bars indicating a 95% confidence interval.

Paired-sample t-tests revealed the following: For the High Mindfulness Memory group, participants' mean "Present Ability" score at T0 was 14.16 (*SD* = 3.50) and increased to 14.92 (*SD* = 3.60) at follow-up, $t(48) = -2.11$, $p = .04$. Similarly, for those in the General Mindfulness group, the mean "Present Ability" score increased from 14.00 (*SD* = 4.40) at T0 to 14.64 (*SD* =4.10) at follow-up, $t(54) = -2.08$, $p = .043$. For those in the Low Mindfulness group, the mean "Present Ability" score did not change from baseline to follow-up ($t(51) = .207$, $p = .84$).

MCI-Potential Improvement. Since the variances of these groups were not homogenous at baseline as determined by Levene's test ($F(2,153) = 3.17$, $p < .001$), we conducted a Welch's *F*-test in order to determine that there were no significant differences among the three group

means on “Potential Improvement” at baseline, *Welch’s F*(2, .96.82) = 2.13, p = .13 (see Appendix A).

Our primary analysis, a one-way ANCOVA revealed the following: the covariate (“Potential Improvement” scores at T0) was significantly related to the follow-up “Potential Improvement” scores, ($F(1,152) = 169.12$, $p < .001$, partial $\eta^2 = .53$; see Appendix A). After adjusting for pre-intervention scores of “Potential Improvement”, there was not a statistically significant difference in post-intervention scores of “Potential Improvement” among the three conditions, $F(2, 152) = 1.62$, $p = .20$, partial $\eta^2 = .021$. See below for the Estimated Marginal Means of the three conditions at T1.

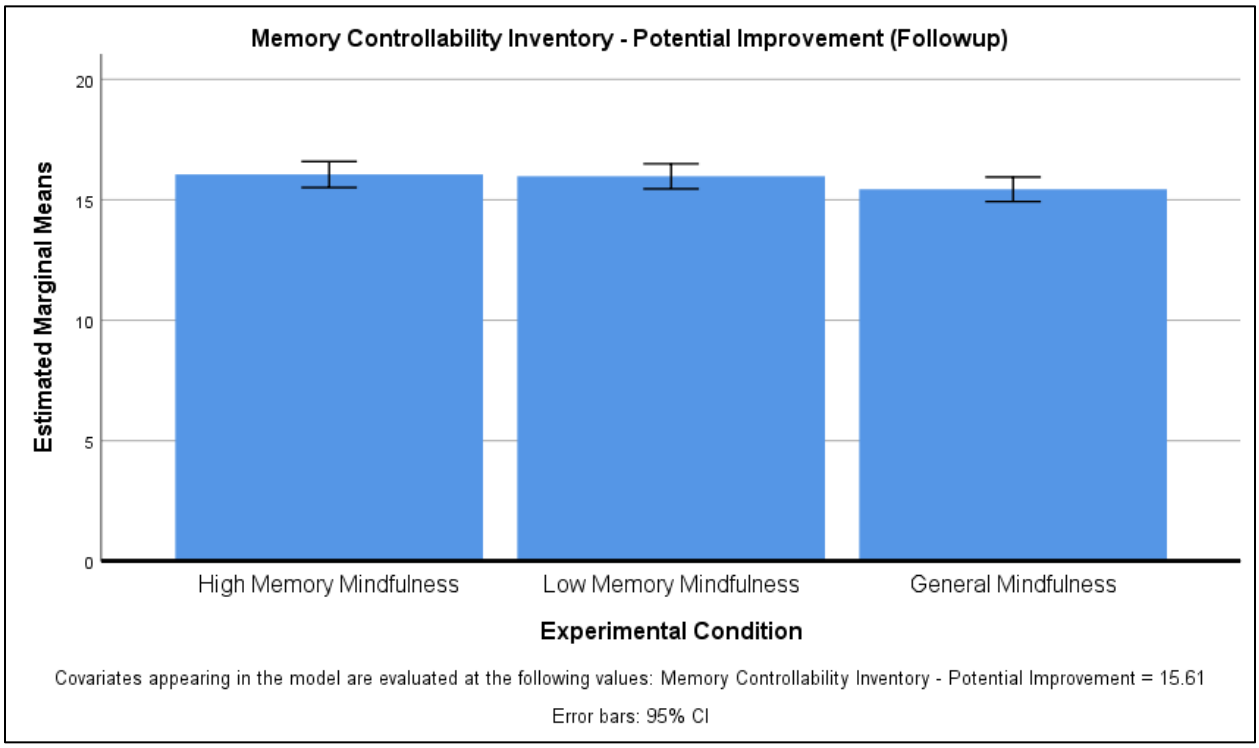

Figure 1.1 Estimated marginal means for “Potential Improvement” at T1. Error bars indicate 95% confidence intervals.

Paired-sample t-tests revealed the following: For the High Mindfulness Memory group, participants' mean "Potential Improvement" score at T0 (M = 14.96, SD =3.36) increased to 15.59 (SD = 2.89) at T1, $t(48) = -1.99$, $p = .052$. Participants' mean "Potential Improvement" score did not change significantly from baseline to follow-up for either the Low Mindfulness Memory group ($t(51) = .21$, p =.23) or for the General Mindfulness group ($t(54) = 1.27$, $p = .21$).

MCI-Effort Utility. A one-way ANOVA revealed that there were no significant differences among the three group means on "Effort Utility" at baseline, $F(2, 153) = .43$, p = .66 (see Appendix A).

Our primary analysis, a one-way ANCOVA revealed the following: As expected, the covariate ("Effort Utility" scores at T0) was significantly related to the follow-up "Effort Utility" scores ($F(1,152) = 147.66$, $p < .001$, partial $\eta^2 = .50$; see Appendix A). After adjusting for pre-intervention scores of "Effort Utility", there was not a statistically significant difference in post-intervention scores of "Potential Improvement" among the three conditions, $F(2, 152) = 1.49$, $p = .23$, partial $\eta^2 = .020$. See below for the Estimated Marginal Means of the three conditions at T1.

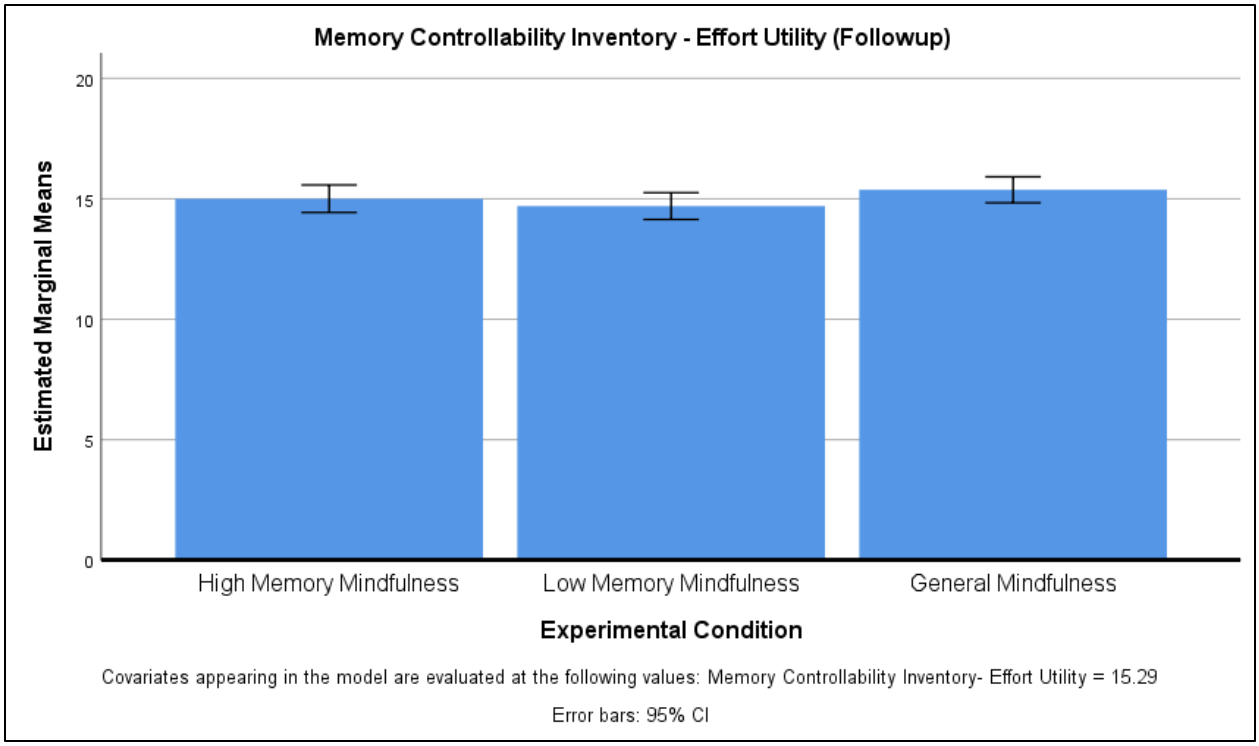

Figure 1.2. Estimated marginal means for "Potential Improvement" at T1. Error bars indicate 95% confidence intervals.

Paired-sample t-tests revealed the following: For those in the Low Mindfulness Memory group, the mean "Effort Utility" score significantly decreased from baseline (M = 15.69, SD = 2.92) to follow-up (M = 14.98, SD = 3.05), t (51) = 2.59, p =.013. Participants' mean "Effort Utility" score did not change after the intervention for either the High Mindfulness Memory group (t(48) = .79, p = .44) nor for the General Mindfulness group, t(54)= -.43, p = .67.

MCI- Independence. A one-way ANOVA revealed that there were no significant differences among the three group means on "Independence" at baseline, F(2, 153) = .61, p = .55 (see Appendix A).

A one-way ANCOVA revealed the following: As expected, the covariate ("Independence" scores at T0) was significantly related to the follow-up "Independence" scores ($F(1,152) = 137.46$, $p < .001$, partial $\eta^2 = .48$; see Appendix A). After adjusting for pre-intervention scores of "Independence", there was not a statistically significant difference in post-intervention scores of "Independence" among the three conditions, $F(2, 152) = .71$, $p = .71$, partial $\eta^2 = .004$. See just below for the Estimated Marginal Means of the three conditions at T1.

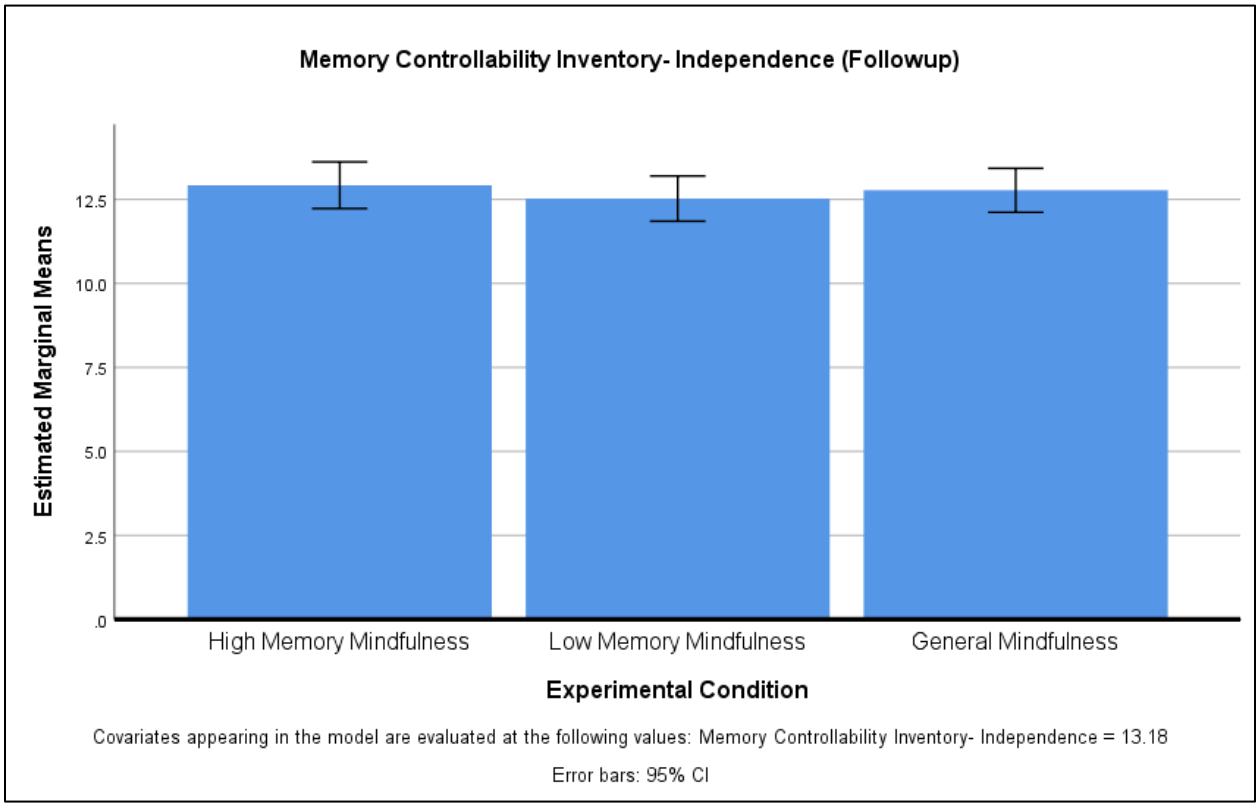

Figure 1.3. Estimated marginal means for "Independence" at T1. Error bars indicate 95% confidence intervals.

Paired-sample t-tests revealed the following: For those in the Low Mindfulness Memory group, the mean "Independence" score decreased from 13.48 ($SD = 3.25$) at baseline to 12.73

(*SD* = 3.57) at follow-up, $t(51) = 2.08$, $p = .043$. Participants' mean "Independence" score did not change between baseline and follow-up for either the High Memory Mindfulness group ($t(48) = .271$, $p = .79$) or the General Mindfulness group ($t(54) = 1.46$, $p = .15$).

MCI- Inevitable Decrement. A one-way ANOVA revealed that there were no significant differences among the three group means on "Inevitable Decrement" at baseline, $F(2, 153) = .79$, $p = .46$ (see Appendix A).

A one-way ANCOVA revealed the following: The covariate, "Inevitable Decrement" scores at T0, was significantly related to the follow-up "Inevitable Decrement" scores ($F(1,152) = 147.66$, $p < .001$, partial $\eta^2 = .50$; see Appendix A). After adjusting for pre-intervention scores of "Inevitable Decrement", there was a statistically significant difference in post-intervention scores of "Inevitable Decrement" among the three conditions, $F(2, 152) = 3.295$, $p = .040$, partial $\eta^2 = .042$. See just below for the Estimated Marginal Means of the three conditions at T1.

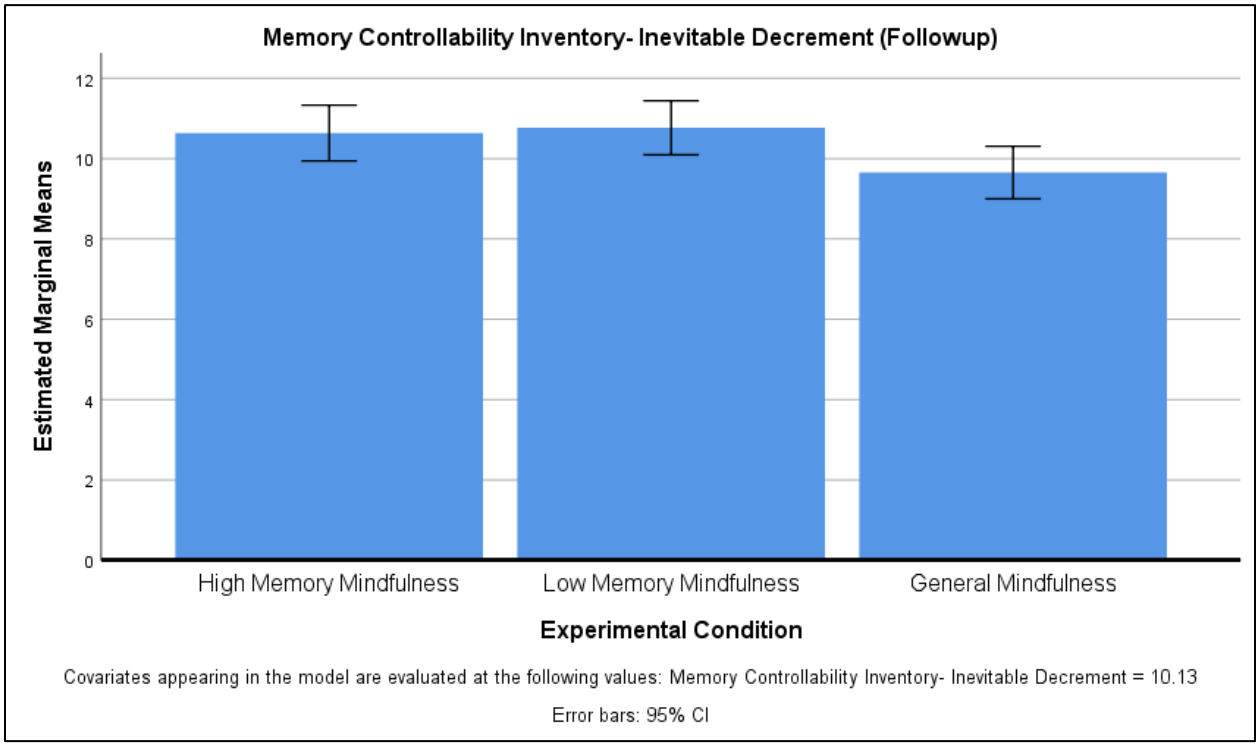

Figure 1.3. Estimated marginal means for "Independence" at T1. Error bars indicate 95% confidence intervals.

Pairwise analyses of the Estimated Marginal Means[4] revealed that the final "Inevitable Decrement" scores were significantly lower in the General Mindfulness group than in either the Low Mindfulness Memory group or the High Mindfulness Memory group (see Figure 17.5). To be more precise, "Inevitable Decrement" scores were significantly lower in the General Mindfulness group than in the Low Mindfulness Memory group (M =10.767, SE=.340), a mean difference of 1.113, 95% CI [.176, 2.049], p = .020. Similarly, "Inevitable Decrement" scores at follow-up were marginally lower in the General Mindfulness condition (M = 9.654, SE = .331) than in the High Mindfulness Memory condition (M = 10.636, SE = .351), a mean difference of .982, 95% CI [.028, 1.936], p = .061. There was no significant difference between the High Mindfulness Memory and Low Mindfulness Memory groups (p = .79).

Paired-sample t-tests revealed the following: For those in the Low Mindfulness Memory group, the mean "Inevitable Decrement" score marginally increased from 9.83 (SD = 3.35) at baseline to 10.54 (SD = 3.32) at follow-up, $t(51) = -1.91$, p =.061. Participants' mean "Inevitable Decrement" score did not change as a result of the intervention in either the High Mindfulness Memory group ($t(48) = -1.07$, p = .29) nor in the General Mindfulness group ($t(54)= 1.19$, p= .24).

MCI-Alzheimer's Likelihood. A one-way ANOVA revealed that there were no significant differences among the three group means on "Alzheimer's Likelihood" at baseline, $F(2, 153) = 1.47$, p = .23 (see Appendix A).

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[4] All post-hoc comparisons of Estimated Marginal Means utilized a Bonferroni correction.

The primary analysis, a one-way ANCOVA revealed the following: As expected, the covariate ("Alzheimer's Likelihood" scores at T0) was significantly related to the follow-up "Alzheimer's Likelihood" scores, $F(1,152) = 227.37$, $p < .001$, partial $\eta^2 = .60$ (see Appendix A). After adjusting for pre-intervention scores of "Alzheimer's Likelihood", there was a statistically significant difference in post-intervention scores of "Alzheimer's Likelihood" among the three conditions, $F(2, 152) = 3.38$, $p = .037$, partial $\eta^2 = .043$ (Appendix A).

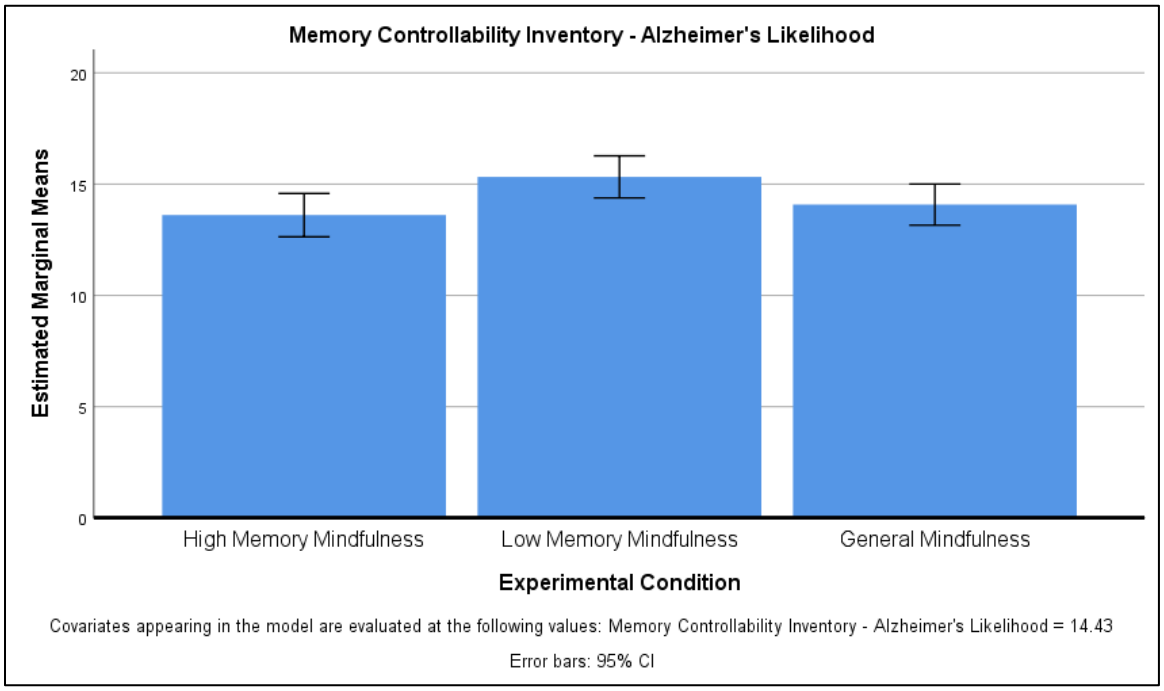

Figure 1.4. Estimated marginal means for "Alzheimer's Likelihood" at T1. Error bars indicate 95% confidence intervals.

Pairwise analyses of the Estimated Marginal Means with a Bonferroni adjustment revealed the following (Appendix A): "Alzheimer's Likelihood" scores were statistically

significantly greater in the Low Mindfulness Memory group (M = 15.33, SE = .48) compared to the High Mindfulness Memory group (M =13.61, SE = .49), a mean difference of 1.72, 95% CI [.06, 3.38], p = .044. Additionally, the pairwise analysis revealed no difference between the General Mindfulness group and the Low Mindfulness Memory group (p =.20) and no difference between the General Mindfulness group and the High Mindfulness Memory group (p =1.0).

Paired-sample t-tests revealed the following: For those in the Low Mindfulness Memory group, the mean "Alzheimer's Likelihood" score marginally increased from 13.87 (SD = 4.69) at baseline to 14.83 (SD = 5.24) at follow-up, $t(51) = -1.88$, p =.066. Participants' mean score did not change for either the High Mindfulness Memory group ($t(48) = 1.46$, p = .15) or the General Mindfulness group, ($t(54) = 1.11$, p= .27).

Research question #2: Subjective memory performance

Our second research question of interest was: Does paying attention to variability in memory performance positively affect one's subjective memory performance?

To assess overall effect of ATV on subjective memory performance, (the number of "yes" responses to daily memory lapses in the past 24 hours in the Everyday Memory Questionnaire), our primary analysis was a one-way ANCOVA.

A one-way ANOVA revealed that there were no significant differences among the three group means at baseline, $F(2, 153) = 1.08$, p = .34 (see Appendix A). A one-way ANCOVA, revealed the following: As expected, the covariate (reported lapses at T0) was significantly related to the reported lapses at follow-up, $F(1,152) = 19.69$, $p < .001$, partial $\eta^2 = .15$ (see Appendix A). After adjusting for the number of reported lapses at T0, there was not a statistically significant difference in post-intervention reports of lapses among the three conditions, $F(2, 152)$

= .90, p = .41, partial η^2 = .012. See just below for a graphical depiction of the estimate marginal means.

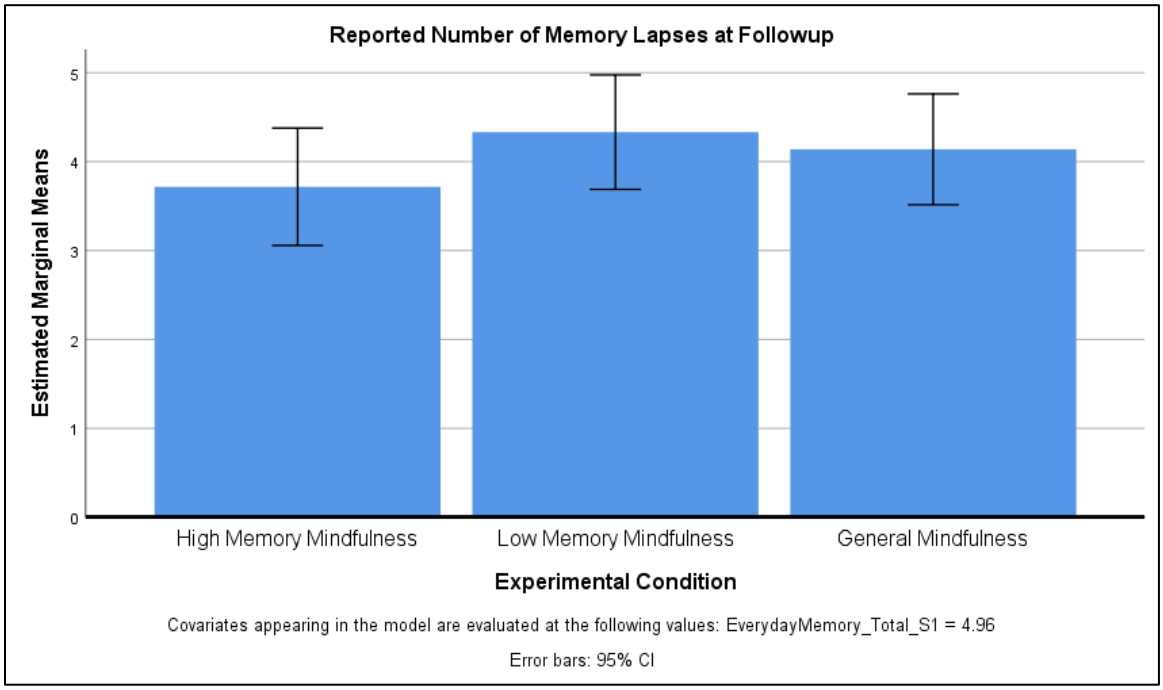

Figure 1.5. Estimated marginal means for Number of Reported Memory Lapses at T1. Error bars indicate 95% confidence intervals.

Paired t-tests revealed the following: There was a significant decrease in the number of reported lapses for those in the High Mindfulness Memory group after the intervention ($M_{Baseline}$= 5.12, [SD = 2.36], M_{Final} =3.78 [SD = 2.26]; t(48) = 3.83, p <.001) and for those in the General Mindfulness group ($M_{Baseline}$ = 5.18, M_{Final} = 4.22; t(48) = 2.57, p =.013). For those in the Low Mindfulness Memory group, there was no significant difference in scores between baseline and follow-up, t(51) = .93, p =.34.

Research question #3: Memory-related stress

Our third research question of interest was: Does paying attention to variability in memory performance positively affect one's memory-related stress?

To assess overall effect of our ATV intervention of how stressed someone is about memory lapses we used Question #2 on the Everyday Memory Questionnaire ("If you answered "yes" to any of the previous questions (1-10), please put an "X" in the box below to rate how stressful in general these memory experiences were for you, with 0 meaning not at all stressful, and 10 meaning very stressful").

A one-way ANOVA revealed that there were no significant differences among the three groups means at baseline, $F(2, 153) = .21$, $p = .81$ (see Appendix A). Our primary analysis, a one-way ANCOVA revealed the following: As expected, the covariate (reported stress at baseline) was significantly related to the reported lapses at follow-up, $F(1,147) = 6.66$, $p = .011$, partial $\eta^2 = .043$ (see Appendix A). After adjusting for the number of reported lapses at T0, there was not a statistically significant difference in post-intervention reports of lapses among the three conditions, $F(2, 147) = 1.02$, $p = .34$, partial $\eta^2 = .015$. See just below for a graphical depiction of the estimated marginal means.

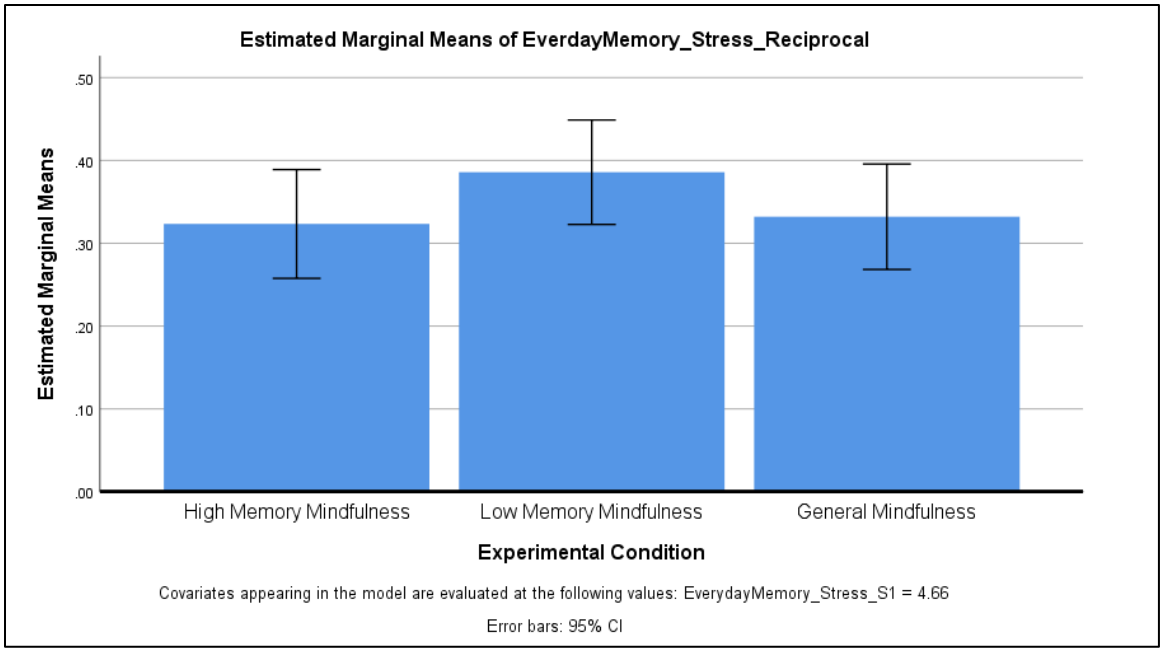

Figure 1.5. Estimated marginal means for Stress about Reported Memory Lapses at T1. Error bars indicate 95% confidence intervals.

Paired t-tests revealed the following: There was a significant decrease in stress levels for those in the Low Mindfulness Memory group ($M_{Baseline}$ = 4.79 [*SD* =2.21], M_{Final}= =3.52 (SD_{T1} = 1.75); t(51) = 3.61, *p* =.001]. There was no significant change in the reported memory-related stress for either the High Mindfulness Memory group (*t*(48) = 1.44, *p* =.16) or for the General Mindfulness group (*t*(54) = 1.36, *p* =.18).

Research question #4: Memory performance

Our final research question of interest was: Does paying attention to variability in memory performance positively affect objective memory performance (scores on the Brief Test of Adult Cognition by Telephone)?

In order to answer this question, we conducted a multivariate analysis of variance (MANOVA), which revealed the following: The differences between conditions on the combined dependent variables was not statistically significant, $F(14, 268) = .894$, $p = .566$; Wilks' $\Lambda = .913$; partial $\eta^2 = .045$.

Next we conducted a series of paired t-tests to determine if there were significant differences between baseline and follow-up on BTACT performance. There were no statistically significant differences between T0 and T1 scores for any of the three groups on any of the subtests of the BTACT (see Figures 68-70).

Research question #5: Trait Mindfulness

Finally, we probed the relationship between trait mindfulness (as measured by the Langer Mindfulness Scale at baseline) and memory-related outcomes at baseline, by calculating Pearson correlation coefficients. We discovered a positive relationship between trait mindfulness and the following: Present Ability ($r = .39$, $p < .001$), Potential Improvement ($r = .29$, $p < .001$), Effort Utility ($r = .23$, $p = .005$), and Independence ($r = .20$, $p = .012$). We also discovered a negative relationship between trait mindfulness and the following beliefs about memory controllability: Inevitable Decrement ($r = -.27$, $p = .001$) and Alzheimer's Likelihood ($r = -.21$, $p = .01$). We did not observe a relationship between the LMS and the following measures: number of lapses reported ($r = -.02$, $p = .80$), stress about memory lapses ($r = .004$, $p = .96$), or any of the sub-tests on the BTACT ($p > .05$).

Exploratory Analyses

As an exploratory analysis, we conducted a series of Pearson's Chi-square tests to determine if whether or not a person improved depended on his/her level of trait mindfulness. To explore this, we tested whether those scoring in the top 25% of the LMS had a higher likelihood

of improving on our outcomes of interest than those scoring in the bottom 25%. The analyses did not reveal a significant effect of LMS quartile on whether an individual improved ($p > .1$, see Appendix A). We also conducted a series of exploratory Chi-square tests[5] to determine the effect of memory concern (as measured on the Everyday Memory Questionnaire) on whether or not they improved on the dependent variables. To explore this possibility, we tested whether those with the top 25% of "Memory Concern" scores differed in their likelihood of improving on our outcomes of interest than those scoring in the bottom 25% of "Memory Concern scores". We found that one's memory concern did affect one's likelihood of improving on the Red-Green Accuracy test on the BTACT, $\chi^2(1, N = 50) = 5.06$, $p = 0.025$, (see Appendix A for the full analysis). Specifically, those with the least concern (bottom 25% of scores) improved, while those with the most concern (top 25% of scores) declined after the week. There was no significant effect of memory concern quartile on the change scores of any of the other measures (see Appendix A).

2.8 Discussion

Over half of older adults aged 70-85 express concerns about their own cognitive decline, particularly memory loss (Commissaris, Ponds, & Jolles, 1998). It is perhaps unsurprising then that a large body of literature indicates that older adults tend to have much lower perceptions of control over their memory than younger adults do (e.g., Hultsch, Hertzog, Dixon, & Small, 1998) and that researchers have had limited success with experimental attempts to change attitudes about memory controllability (e.g., Lachman, 2004). Our research question was: can we increase

[5] In the cases with fewer than 10 participants in a cell, we conducted a Fisher's Exact Test.

perceptions of control and memory performance by challenging the belief of perpetual memory lapses?

In this study, we conducted an experiment to determine the effects of an "attention to variability" (ATV) training paradigm in older adults (N = 156, ages 65-80) who expressed concerns about their memory. Specifically, we trained participants to pay attention to the natural fluctuation in their memory performance over the course of six days using text-message prompts. In addition to the group that received the ATV training, we included two comparison groups that also received six days of text-message prompts: 1) a group that was asked to pay attention to their memory performance (but not the fluctuation; "Low Mindfulness Memory"), and 2) a group that was asked to report on the activity they were engaged in over the past 30 minutes ("General Mindfulness"). Our main outcome measures were changes in memory efficacy beliefs (Memory Controllability Inventory), subjective memory performance (Everyday Memory Questionnaire), stress about memory failures (Everyday Memory Questionnaire), and actual memory performance on a telephone-based cognitive battery (BTACT).

As predicted, we found positive effects of the ATV intervention, with the High Mindfulness Memory group reporting significantly fewer lapses in their memory after the intervention ($p < .001$), along with evidence of increased perceptions of control over their memory. Specifically, those in the High Mindfulness Memory group became marginally more likely to feel control over their present memory ability ($p = .04$) and endorse the potential for memory improvement ($p = .052$) after the six-day intervention.

On the other hand, we found the opposite effect in those who were asked to pay attention to their memory performance every morning, not the fluctuation (the "Low Mindfulness Memory" group). Specifically, this group evidenced declines in reported beliefs about memory

controllability including: significantly decreased beliefs in the utility of efforts to improve memory ability (p = .013), along with marginally decreased beliefs about control over their independence (p = .06), marginally increased beliefs about memory decline being inevitable (p = .06), and marginally increased beliefs about the likelihood of developing Alzheimer's Disease (p = .06). These findings, which all travel in the same direction, suggest that drawing one's attention to stability of symptoms results in feelings of less control.

Given the focus on stability, it is unsurprising that the Low Mindfulness Memory group did not report any change in memory lapses after the week. Those in this group also demonstrated significantly reduced stress about memory lapses (p =.001). This reduced stress may have indicated relief or comfort in perceived stability, a phenomenon supported by past literature (e.g., Agrigoroaei et al., 2013).

We also found that noticing and reporting on the activities they were engaged in over the past 30 minutes (the task of the "General Mindfulness" group) produced positive effects. Specifically, participants in this group became marginally more likely to feel control over their present memory abilities (p = .043) and significantly less likely to report memory lapses (p =.013) than at the beginning of the study. We initially included this comparison group to control for the effects of feeling engaged in the study. Upon further consideration, it seems that the instructions for this group also emphasized personal action, which the literature suggests is associated with increased perceptions of control (e.g., the effects of personal decision making and planning for future action; Langer & Rodin, 1976; Schultz, 1980; Lachman & Burack 1993). Another reason the General Mindfulness group might have improved is that the participants were generating evidence of their successful attempts of autobiographical retrieval (i.e., remembering what they had done in the past 30 minutes). In the future it would be interesting to compare this

group against one that was asked to report on another self-relevant detail from the past 30 minutes (e.g., mood) that did not emphasize personal action. Adding this group could help us disambiguate the effects of emphasizing personal action and the successful retrieval of a past event.

Beyond perceptions of control and subjective memory performance, we were also interested in whether our interventions would result in changes in performance on a cognitive battery. We did not find any support for this hypothesis, as scores on memory and go/no-go switch tasks did not significantly change between baseline and follow-up on the Brief Test of Adult Cognition by Telephone for any of the groups. This finding is in line with the literature that describes how beliefs about memory controllability and actual performance often do not travel together (Beaudoin & Desrichard, 2011; Crumley, Stetler, & Horhota, 2014). In addition, it would be important to consider motivations to perform on this memory test, as researchers have demonstrated that older adults demonstrate better memory performance when they are motivated to do well (e.g., Langer et al., 1979). Later research found that older adults' memory strategies change based on their motivations to succeed on a given task (Benjamin, 2007; Castel, 2007; Castel, Balota, & Mccabe, 2009), and that they may even deploy strategy more efficiently than younger adults (Castel, Murayama, Friedman, Mcgillivray, & Link, 2013).

Finally, we found the predicted significant relationships between trait mindfulness and control beliefs about memory. We discovered a positive relationship between trait mindfulness (as measured by the Langer Mindfulness Scale) and the following variables: Present Ability (r = .39), Potential Improvement (r = .29), Effort Utility (r = .23) and Independence (r = .20). We also discovered a negative relationship between trait mindfulness and the following beliefs about memory controllability: Inevitable Decrement (r = -.27, p = .001) and Alzheimer's Likelihood (r

= -.21, p = .01). Before this study, none had investigated the relationship between trait mindfulness and beliefs about controllability. The LMS has been previously associated with positive mental health outcomes in healthy populations (Pagnini, Bercovitz, & Phillips, 2018; M. A. Pirson, Langer, & Zilcha, 2018), along with samples of patients with Amyotrophic Lateral Sclerosis and their caregivers (Pagnini et al., 2015, 2016). The fact that the trait mindfulness is related to memory controllability beliefs supports the rationale to identify experimental protocols that increase mindfulness.

Future directions

One area that warrants further exploration is the "dosage" of the ATV mindfulness intervention. Specifically, we would like to systematically test whether more messages per day or more days produce a stronger effect. For example, Zilcha-Mano and Langer (2016) found effects of an ATV intervention that prompted participants to respond to two text messages per day for two weeks. On the other hand, the effects found by Delizonna et al. (2009) were observed after only one week of prompts, though these prompts were delivered every 3 hours. While it is possible that a longer intervention would have produced a stronger effect, it is also possible that participants would have responded just as well to a shorter intervention. A future study could randomly assign participants to interventions of different lengths and "dosages". In addition, we could investigate how long the effects lasted after different dosages.

Related to the "dosage" of the intervention is the question of the spacing of our text messages. We chose to follow the protocol as described by Zilcha-Mano and Langer (2016), which described two text-message prompts per day. A few older adults reported informally during the follow-up phone call that the text-messaging window (describing the last 30 minutes)

was not large enough to capture the day's important memory failures (e.g,, forgetting their laptop to teach a class). This indicated that older adults may be eager to report and understand more concerning memory failures, rather than the ones that happen to fall in the time frame of the randomly scheduled messages. In the future, we could investigate how understanding the variability in these more serious lapses could affect their memory controllability. For example, we could prompt participants to reflect on the whole day and journal about the reasons that they might have experienced the memory lapses.

Another future direction would be to analyze the responses to the text message prompts, which would allow us to investigate the metacognitive abilities and memory control beliefs. Specifically, we collected information about how those in the High Mindfulness group rated their memory performance and also how they compared the performance to the last time we prompted them. In theory, we can compare the ratings at two adjacent time points to determine if the person was correct in rating whether it was better or worse since the last time we asked them. We may find that some older adults are more "accurate", while some demonstrate a positive or negative bias. It would be interesting to investigate whether an accurate or positive bias would be more associated with reports of memory controllability.

Another important addition to a future study would be a waitlist control group to determine the effects of the passage of time on our dependent variables of interest. While the current study did have the benefit of pre- and post- tests, along with comparison groups, a waitlist control group would strengthen the inferences we could draw, as it would allow us to parse out any testing effects. This would be especially important if the general mindfulness group attended to memory, which is possible given that the first survey had many questions asking them to evaluate their memory performance.

One potential limitation of the present study was that some of the older adults were not very concerned about their memory initially, which is not surprising given the consistent finding that older adults demonstrate a positivity bias in both memory and attention tasks (Mather & Carstensen, 2005). In pretests, we had trouble finding older adults who would rate their concern as higher than 4 out of 7 on a Likert scale, so we decided to relax the inclusion criteria to "Would you say you are at all concerned about your memory?" On our prescreening survey, participants rated their level of concern as 2.82 on a scale of 1 (not at all concerned) to 5 (very concerned). Our exploratory analysis indicated that it may actually be those who are less concerned about their memory who improve on cognitive tests. A future investigation could recruit older adults who are concerned, along with those who are not and systematically compare the effects of our mindfulness interventions.

Another potential limitation of the study was that the demographics were skewed to largely represent one group, namely highly educated Caucasian women. Future studies should attempt to recruit a broader and more broader demographic sample, as has been recommended by the field (e.g., Arnett, 2015) . As a note of practical advice to researchers relates to using Google's Boomerang platform to schedule text messages. Specifically, this platform does not integrate well with text messages sent through the telecommunications company, Sprint. Sprint customers were required to receive our prompts through their email accounts, with notifications turned on so that they would not miss our messages. This may have changed the experience for these participants, especially those who were not used to having phone notifications turned on.

Overall, we found positive effects of attending to fluctuation in memory ability after only six days on both subjective memory ability and memory controllability beliefs. Further research will help us better isolate why the High Memory Mindfulness and General Mindfulness groups

both improved, along with elucidating the role of concern in the effectiveness of the interventions.

2.9 Conclusions

In this study, we investigated the "attention to variability" paradigm in older adults with memory concern, which is situated in the broader discussion of successful aging (Rowe & Kahn, 1987) and the biopsychosocial model of development. Successful aging is a product many factors, including challenging expectations about what it means to get older. From a young age, we learn a narrative about aging, which prominently features decline. For many of us, this story will be interpreted mindlessly and unconditionally such that we will come to view certain arbitrary experiences (e.g., lower back pain at age 50) as definitive markers of an uncontrollable aging process. That is, some of us will choose to create a reality of aging by reinforcing it through our interpretations of personal experiences (e.g., *lower back pain at age 50 must necessarily mean I'm aging and declining rather than being related to the gardening activities I am currently engaging in*).

It also remains unclear what exactly researchers mean when they talk about "aging." The reality of most of our life experiences is that they exist as multiple, separate, and temporary states (e.g., lower back pain at age 50 and forgetting where one has placed their keys at age 50 may be two separate, unrelated, and temporary experiences). Our inclination, however, is to try to connect isolated experiences into a coherent story. The "aging" story seems to have evolved as a way to link together all experiences of loss or decline occurring at a later chronological stage. Moreover, this linking of seemingly-related experiences contributes to a view of "aging" as an ongoing, uncontrollable, and permanent process. There is a lot of variance in the aging process, however. In fact, there is as much variation among "older adults" as there is among "younger

adults," which suggests that there isn't one monolithic aging experience, but rather one for each person that is changing all the time. In the future, we'd like to further investigate the effects of teaching older adults to observe the variability in many experiences typically associated with advanced age, including eyesight, hearing ability, balance, and taste. More generally, we will continue to investigate how challenging the dominant view of aging could improve health and well-being for older adults.

Chapter 3. Perceptions of control and chronic pain experience

3.1 Chronic pain definition and clinical import

According to the International Association for the Study of Pain, pain is defined as the unpleasant sensory and emotional experience resulting from actual or potential tissue damage (International Association for the Study of Pain, 1979). In contrast to nociception, the working definition of "pain" requires a negative emotional appraisal.

Cited as one of the most common reasons that patients seek medical attention (Komaroff, 1990; Schappert, 1992), pain is categorized either as acute or chronic. While acute pain signals the pain experiencer of potential injury, chronic pain persists over a period of at least three months (Treede et al., 2015). In contrast to acute pain, which is often considered a symptom of an underlying disease or illness, chronic pain can be considered a disease in its own right (Goldberg & McGee, 2011).

Chronic pain is estimated to affect about 1 in 5 adults across the globe, with 1 in 10 developing a chronic pain condition each year (Gureje, Korff, Simon, & Gater, 1998). In the United States, 25.3 million adults (~11% of the population) reported having pain every day for the past three months (National Health Institute Survey, 2012).

Most chronic non-cancer pain falls into one of three categories: osteo- and rheumatoid arthritis (40%), pain related to operations and injuries (25%), and spinal issues (20%; International Association for the Study of Pain International Association for the Study of Pain).

The widespread effects of pain. The pain experience affects not only the individual's wellbeing and ability to perform everyday tasks, but also takes a toll on interpersonal relationships and the society, at large. These factors will be reported in the sections below.

Pain effects on everyday functioning, social relationships, and finances. The chronic pain experience affects one's ability to exercise, sleep well, perform household duties, maintain social relationships, and live independently (as reviewed in Dueñas, Ojeda, Salazar, Mico, & Failde, 2016).

Experts estimate that the economic cost of chronic pain is comparable to that of cancer or cardiovascular disease (around 635 billion dollars per year; Gaskin & Richard, 2012). Specifically, chronic pain results in lost productivity at work, absenteeism, and places financial burdens of care on family and friends.

Pain's comorbidity with psychological disorders. Many research studies have noted the comorbidity between psychological disorders and chronic pain (for a review of the relationship between chronic pain and depressive and anxiety disorders see Bair, Robinson, Katon, & Kroenke, 2003) . One large-scale study from the World Health Organization (n=25916) found a relationship between pain and psychological disorders in all 15 sites across 14 countries in Asia, Africa, Europe, and the Americas (Gureje et al., 1998). Specifically, people reporting persistent pain were significantly more likely to meet the *International Statistical Classification of Diseases 10th Edition* (ICD-10) criteria for depressive and anxiety disorders.

While the link between chronic pain and mental disorders is robust, the mechanism is not well understood (Dersh, Polatin, & Gatchel, 2002). Specifically, it is not known whether depression causes pain, pain causes depression, or some third factor causes both. One notable finding is that antidepressants used to treat depressive and anxiety disorders (TCAs and SNRIs) have been found to modulate both neuropathic pain and fibromyalgia (Arnold et al., 2004, 2005).

The created pain experience. While the sensory aspects of pain are often emphasized, pain is, in fact, a unique construct in that it is shaped by both bodily sensations and emotional

appraisal (Treede et al., 2015). In other words, pain is a result of both sensations and one's interpretation of those sensations.

A thorough understanding of the pain experience requires identifying the surrounding biopsychosocial context (Gatchel et al., 2007). For example, researchers have found that electric shocks are rated as more painful when the participant believes that a confederate delivered an electric shock on purpose rather than accidentally (Gray & Wegner, 2008). Substantial evidence suggests the role of psychosocial factors in the development of chronic pain and the pain experiencer's ability to cope with it (for a review see Edwards, Dworkin, Sullivan, Turk, & Wasan, 2016) Some of these psychosocial factors include orientation towards pain (Tsur, Defrin, & Ginzburg, 2017), pain appraisals (Jackson, Wang, & Fan, 2014), pain catastrophizing (Sullivan, 2012), and pain-related fears including fear of pain, fear of exercise, and fear of (re)-injury (Crombez, Vlaeyen, Heuts, & Lysens, 1999; Vlaeyen & Linton, 2000).

The pain experience is also affected by the experiencer's health beliefs, including one's health locus of control beliefs and beliefs about the pain experience. For example, Williams and Thorn (1989) found that those who believed that pain would be enduring showed poor compliance to health advice from medical professionals. The next section will focus on perceptions of control in the pain experience.

3.2 Chronic pain and perceptions of control

One important psychological factor that influences the experience of chronic pain is a perception of control over the pain. It is well-established that giving people control over pain (whether it be acute or chronic) reduces pain severity (e.g., Weisenberg, Wolf, Mittwoch, Mikulincer, & Aviram, 1985). Indeed, perceived control has been found to moderate the pain

response. A recent meta-analysis from more than 15,000 responses determined that self-efficacy had a significant negative relationship with functional impairment (r=-.49), affective distress (r=-.43), and pain severity (r=-.39) in chronic non-cancer pain (Jackson, Wang, Wang, & Fan, 2014).

Researchers have found that chronic pain patients who demonstrated a chance locus of control (i.e., attributing pain severity to chance) were more likely to experience depression, obsessive-compulsive symptoms and psychological distress; additionally these individuals were more likely to rely on distraction and prayer to relieve symptoms rather than employing active coping strategies (Crisson & Keefe, 1988).

Given the importance of perceiving one is in control of the pain experience, it is essential that researchers understand how to change maladaptive beliefs about the pain experience. Importantly, researchers found that perceptions of control over pain can be manipulated experimentally. For example, chronic pain patients randomly assigned to a short-term in-patient multidisciplinary pain management program saw increases in perceptions of control over pain as compared to those assigned to the control group (Lipchik, Milles, & Covington, 1993).

3.3 The role of attention in the pain experience

The attention to variability paradigm (introduced in Chapter 1) would theoretically benefit the noncancer chronic pain patient by teaching them to challenge the limiting belief that pain sensations are stable across time. Through the process of moving the attributions from the external to the internal (i.e., becoming more agentic over the pain experience), patients could see increased functionality, more positive affect, and less pain severity.

On the other hand, it is also possible that asking participants to pay attention to any aspect of their pain sensations could make the pain experience even more severe in some people. Specifically, this type of exercise could result in patients focusing on negative aspects of the experience or becoming hypervigilant when the threat value of the pain is determined high (i.e., in the case of fear of pain and fear of re-injury; Crombez, Van Damme, & Eccleston, 2005)

Pain regulation: Distraction and focus. Two primary mechanisms that researchers have explored in down-regulating the sensory pain experience are distraction and focused attention (as discussed in Veldhuijzen, Kenemans, Bruin, Olivier, & Volkerts, 2006). Distraction requires that participants disengage from the pain experience and reengage in a concurrent sensory experience (e.g., auditory, visual, somatosensory) unrelated to their pain. Researchers have found in healthy young adults that the processing of pain and highly demanding tasks interfere with each other (Veldhuijzen et al., 2006); the authors, in turn, suggest that pain patients may benefit from highly challenging distractions.

At the same, researchers have discovered the practical difficulties that chronic pain patients have shifting attention away from pain (e.g., Wiech, Ploner, & Tracey, 2008). In other words, patients have trouble disengaging from the current pain experience to attend to another somatosensory experience or cognition. The issue of motivation comes into play, as well, as many patients are unmotivated to shift their attention away from pain information. In fact, van Damme and colleagues (2010) concluded in their review paper that focusing on pain-relevant stimuli was more effective in down-regulating pain than non-pain-relevant stimuli. Focused attention to pain sensation has been shown to down-regulate pain. Specifically, researchers have found that asking participants to focus on a particular aspect of the nociceptive experience (e.g., the severity or location of the sensation) reduces pain in healthy people (Nouwen, Cloutier,

Kappas, Warbrick, & Sheffield, 2006) and those with chronic pain (Roelofs, Peters, van der Zijden, & Vlaeyen, 2004).

There has also been one investigation of the attention to variability paradigm in the pain context, which is under review for publication. This research focused on healthy volunteers to understand the influence of mindfully attending to a painful stimulus on Conditioned Pain Modulation (CPM; Tsur, Defrin, Haller, Bercovitz, & Langer, unpublished). In this study, undergraduates were randomly assigned to one of three groups: a control group, a pain-specific mindfulness group, or a non-pain-specific mindfulness group. The pain-specific mindfulness group was instructed to pay attention to the variability in a noxious thermal stimulus. We found that those in the control group (who were instructed to sketch) demonstrated a maladaptive response (a reduced modulation) to the noxious stimuli, whereas in the mindfulness groups did not, suggesting the positive effects of an ATV intervention, even in a single session. This study with healthy undergraduates was a first step to investigating the ATV phenomenon in chronic pain patients.

3.4 Research questions and hypotheses for study 2

In Study 2, we investigated whether teaching people with chronic non-cancer pain to notice how their pain severity/unpleasantness changes over time can decrease their pain severity and reports of pain interference in their daily lives, and increase perceptions of control over pain, beliefs about pain as constant. We generated four primary research hypotheses and one secondary hypothesis. Our primary hypotheses included:

1. Those in the High Mindfulness Pain condition will exhibit significant increases in beliefs about how much they can control their pain (i.e.., increases in the MHLC-Form C

"Internal" subscale) after the ATV intervention, while those in the comparison groups will not.

2. Those in the High Mindfulness Pain condition will exhibit significant decreases in beliefs about pain being constant (as measured by the PBAPI) after the ATV intervention, while those in the comparison groups will not.
3. Those in the High Mindfulness group over one week will exhibit significant decreases in pain interference (as measured by the SF-36) after the ATV intervention, while those in the comparison groups will not.
4. Those in the High Mindfulness Pain condition will decease significantly on measures of pain severity after one week (as measured by the BPI), while those in the comparison groups will not
5. Those in the High Mindfulness group over one week will exhibit significant decreases in pain catastrophizing (as measured by the PCS) after the ATV intervention, while those in the comparison groups will not.

Our secondary hypothesis was:

1. There will be a negative relationship between the Langer Mindfulness Scale and negative control beliefs, pain interference, and pain severity.

3.5 Methodology for study 2

Participants

Recruitment. Participants were recruited from Tufts Medical Center and a private pain practice in the Greater Boston Area with the help from study collaborators Dr. Rina Bloch, Dr. Sameer Kapasi, Dr. Feng Wang, Dr. Robert Edwards. These physicians posted flyers in their waiting room and handed out physicians' letters of support at the end of their patients'

appointments. In addition, Dr. Asmina Lazaridou sent out an email to previous chronic pain patients who had participated in research studies before. Participants were also recruited from two social media sites: Reddit.com and Facebook.com. Specifically, we posted information about the prescreening process on the following subreddit groups, which are chronic pain support groups: r/ChronicPain (23 k subscribers), r/migraine (22 k subscribers), r/Thrits (3.5 k subscribers), r/neuropathy (551 subscribers), r/rheumatoid (4.6 k subscribers). We also delivered a Facebook ad to those living in the United States who were connected to pain support groups.

Inclusion and exclusion criteria.

Inclusion criteria. We recruited people who live in the United States, indicated that they were aged 18+, fluent in English, and owned a smartphone that they would be willing to use for the study. Additionally, they were required to respond "yes" to the question, "Do you experience chronic pain?"

Exclusion criteria. Exclusion criteria were as follows: Individuals under the age of 18; Individuals who did not endorse their pain as chronic; Individuals who were pregnant; Individuals with diagnosed cognitive impairment; Individuals who would not be able to read text messages because of visual impairment; Individuals with a spinal cord injury or active cancer; Amputees; Individuals with unhealed fractures; Diabetics who did not have symptoms under control; Individuals who reported visits to a doctor for a fall in the last 6 months; Individuals with the diagnosis of schizophrenia. These exclusion criteria were suggested by Dr. Rina Bloch, a medical doctor who specializes in chronic pain.

Sample size. Sample size was determined in order to have enough power to detect an effect given the analysis, a one-way ANCOVA. Specifying this test with three groups, statistical power =.80, $\alpha = .05$, and expecting a medium effect size, our power analysis suggested a final

sample size of 52 per group (Total *N*= 156; Cohen J., 1992). This effect size is based on Delizonna and colleagues' study using the ATV paradigm (Delizonna et al., 2009), which reported an ETA = .23. Delizonna et al. (2009) also reported a 25% data attrition rate, indicating initially that we should aim to recruit 65 individuals per group (Total *N* = 195 individuals). Early on, we checked the attrition rate, which was much higher than we anticipated (around 40%). Therefore, we monitored recruitment until we had usable data from 156 individuals (M_{age} = 43.80, *SD* =15.19; 141 female). In total, we recruited 300 individuals. Participants were excluded from analysis for the following reasons: (1) they did not complete at least 2/3 of Survey 1; (2) they had technical difficulties in receiving our text messages or they were sent on the wrong schedule, (3) they did not respond to at least 2/3 of their scheduled text messages (i.e., 8 out of 12), or (4) they did not respond to at least 2/3 of the second survey. One person who signed the informed consent was later found to be ineligible for participation, so that individual was not included in the final analysis. For a chart of attrition and demographic information, see just below.

Table 2.0. Attrition of pain study participants.

Enrolled	300	
Did not meet inclusion criteria	1	299
Quit	13	286
Did not complete 2/3 of S1	22	264
Technical difficulties	23	241
Did not complete 2/3 of text messages	52	189
Did not complete 2/3 of S2	29	160
Data collected after cutoff met	4	156

Table 2.1 Participant characteristics of pain study

Age (in years)		
	18-24	22
	25-34	26
	35-44	31
	45-54	33
	55-64	32
	64-74	13
	75+	2
Gender		
	Female	141
	Male	12
	Other	3
Education		
	High School Graduate	13
	Some College, no degree	40
	Associates Degree	18
	Bachelor's Degree	47
	Master's Degree	26
	Doctorate	7

Table 2.1 Participant characteristics of pain study (Continued)

	Professional Degree (JD, MD)	5
Marital Status		
	Single	58
	Married	64
	Widowed	5
	Separated	2
	Divorced	20
	Civil Union	1
	Other	4

Household Income		
	Less than $10,000	8
	$10,000 to $19,999	16
	$20,000 to $29,999	20
	$30,000 to $39,999	11
	$40,000 to $49,999	10
	$50,000 to $59,999	16
	$60,000 to $69,999	10
	$70,000 to $79,999	7
	$80,000 to $89,999	1
	$90,000 to $99,999	6
	$100,000 to $149,999	28
	$150,000 or more	15
	Prefer not to answer	8
Employment Status		
	Working (paid)	69
	Working (self-employed)	12
	Not working- Temporary lay-off	0
	Not working- Looking for Job	8
	Not working- Retired	16
	Not working - Disabled	34
	Not working - Other	8
	Not working- Student	7
	Prefer not to answer	2
Race		
	Hispanic, Latino	6
	Non-Hispanic, Latino	150
	Caucasian/White	146
	African American/Black	4
	More than one race selected	5

Table 2.1 Participant characteristics of pain study (Continued)

	Prefer not to answer	1
Religious		
	Yes	72
	No	80
	Prefer not to answer	4

Table 2.2. Pain characteristics for pain study participants.

Seen Physician in Last Year for Pain?		**Total**
	Yes	138
	No	8
	N/A	10
Official Diagnosis Received?		
	Yes	120
	No	22
	N/A	5
Official Diagnosis		
	Multiple	48
	Fibromyalgia	9
	Migraine	2
	Chronic Pain	6
	Arthritis	27
	Herniated Discs/Degenerative Disc Disease	3
	Ehlers-Danlos/ Hypermobility Syndrome	4
	Complex Regional Pain Syndrome	6
	Other	17
Duration of Pain (in months)		
	Mean	101.69
	Median	60

	St. Deviation	103.17
	Range	4-624

Table 2.2. Pain characteristics for pain study participants (Continued).

Usual Level of Pain (past week)[6]		
	Mean	5.96
	Median	6
	St. Deviation	1.73

Measures

Primary outcome measures.

Visual analog scale (VAS) for sensory magnitude and affect. The visual analog scale asks participants to separately rate the intensity and unpleasantness of their pain experience "right now" by making a mark on a horizontal line with one end indicating no pain and the other end indicating extreme pain. This measurement approach was validated for chronic pain and experimental manipulations involving noxious thermal stimuli (e.g., Price, Mcgrath, Rafii, & Buckingham, 1983; Wewers & Lowe, 1990). We have adapted this to an online format by using a sliding scale. For the intensity rating, participants are asked to place a mark on a vertical line between 0 and 100 with 0 indicating "no pain sensation" to 100 indicating "most intense pain imaginable". For the unpleasantness rating, participants are asked to place a mark on a vertical

[6] Participants responded to the question during the prescreening survey: On a scale of 0 to 10, with 0 being "no pain at all" and 10 being "the worst pain imaginable", how would you rate your USUAL level of pain in the past week.

line between 0 and 100 with 0 indicating "not at all unpleasant" to 100 indicating "most unpleasant imaginable."

Pain Beliefs and Perceptions Inventory (PBAPI; Williams & Thorn, 1989). This self-report assessment includes 16 questions, which originally described three subscales including: Time (the belief that pain will be enduring, e.g., "I am continuously in pain"), Mystery (the belief that the causes of pain are mysterious, e.g., "I can't figure out why I am in pain"), and Self-Blame (the belief that the patient is to blame for the pain, e.g., "If I am in pain, it is my own fault"). The authors found that the Time subscale significantly predicted reported pain intensity in chronic pain patients (D. A. Williams & Thorn, 1989). Additionally, the Time and Mystery subscales were significantly correlated with poor self-esteem. Further investigations demonstrated that chronic pain patients who scored high on the Time and Mystery dimensions were less likely to use cognitive coping strategies (e.g., reappraisal; Williams & Keefe, 1991). A more recent investigation by the primary author (Williams, Robinson, & Geisser, 1994) favors a four-factor structure which separated the "Time" dimension into "Pain Constancy" and "Pain Permanence."

Multidimensional Health Locus of Control Scale – Form C (MHLC-Form C; Wallston, Stein, & Smith, 1994). Based on the Multidimensional Health Locus of Control Scales (Wallston, Wallston, & Devellis, 1978), the MHLC-Form C is an 18-item self-report instrument that was designed to measure control beliefs in a wide variety of health-related conditions. The scale requests that participants indicate how much they agree with each of the statements from 1 (*Strongly Disagree)* to 6 (*Strongly Agree).* The scale was and was originally validated in two samples that included patients with rheumatoid arthritis, chronic pain, cancer, and diabetes. The scale has four subscales which differentiate whom the participant attributes

control of the health condition: internal (e.g., “I am directly responsible for my condition getting better or worse.”; six items, α = .85-.87), chance (e.g., “If I am lucky, my condition will get better”; six items, α =.79-.82), doctors (e.g., “If I see my doctor regularly, I am less likely to have problems with my condition”; three items, α = .71), and other people (e.g., “Other people play a big role in whether my condition improves, stays the same, or gets worse.”; three items α = .70-.71). The authors reported how scores of these subscales changed as a result of a pain management program that was designed, in part, to decrease pain helplessness. In this sample of chronic pain patients, scores on the internality subscale increased, while scores on the three “external” subscales decreased. In terms of construct validity, the internality subscale was negatively correlated with pain levels and pain helplessness. The “Chance” externality subscale was positively correlated with depression (r = .33) and pain helplessness (r = .27), The “Doctors” externality subscale was positively correlated with reported pain (r = .17) and helplessness (r = .17). Finally, the “Other People” externality subscale was positively correlated with reported pain (r = .26) and helplessness (r = .40).

The MOS 36-Item Short-Form Health Survey (SF-36; J. E. Ware, Jr., & Sherbourne, 1992). The SF-36 is self-administered general health survey, which is composed of 36 questions spanning eight dimensions, including: 1) limitations in physical activities because of health, 2) limitations in social activities because of health or emotional problems, 3) limitations in ability to fulfill typical roles because of physical health problems; 4) limitations in ability to fulfill typical roles because of emotional problems 5) bodily pain; 6) general mental health, 7) vitality, and 8) general health perceptions. The scale has demonstrated good psychometric properties, including reliabilities over .80 (McHorney, Ware, Jr., Lu, & Sherbourne, 1994; McHorney, Ware, Jr., & Raczek, 1993). Instead of asking participants to respond to their health over “past four weeks”,

we asked about the "past week" in order to assess the affect of our six-day text message intervention.

Brief Pain Inventory- Short (BPI-sf; Daut, Cleeland, & Flanery, 1983). This 9-item self-report scale measures the severity of pain and the impact of pain on functional health. Specifically, the BPI-sf asks participants to rate the worst, least, average, and current pain, along with perceived interferences in various life domains including: general activity, mood, walking ability, work inside and outside of the home, social relations, sleep, and enjoyment of life. Originally validated in cancer patients (Cleeland CS., 1991), the BPI has also been validated in those with non-cancer pain (Keller et al., 2004). We primarily focused on the following two questions: 1) "Please rate your pain by marking the box beside the number that best describes your pain on average (0 = *no pain* and 10 = *pain as bad as you can imagine)"* and 2) "Please rate your pain by marking the box beside the number that best describes your pain right now (0 = *no pain* and 10 = *pain as bad as you can imagine)"*

Pain Catastrophizing Scale* (*PCS; Sullivan, Bishop, & Pivik, 1995). The Pain Catastrophizing Scale is a 13-item self-report instrument that asks respondents to consider how much they experienced 13 different thoughts/feelings when in pain on a five-point scale with 0 indicating *Never* and 4 indicating *All the time.* The PCS yields a total score, as well as scores for three subscales: "Rumination", "Magnification", and "Helplessness". An example item of the "Rumination" subscale is: "I keep thinking about how much it hurts." An example item of the "Magnification" subscale is: "I become afraid that the pain will get worse." An example item of the "Helplessness subscale is: "There's nothing I can do to reduce the intensity of my pain." The authors reported excellent internal consistency for all the subscales (Total score alpha coefficient

= .87; “Rumination” alpha coefficient = .87; “Magnification” alpha coefficient = .66; “Magnification” alpha coefficient = .78; Sullivan et al., 1995).

Secondary Measures

Langer Mindfulness Scale. See Chapter 2 for a complete description of this measure.

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The Hospital and Anxiety Depression Scale is comprised of 14 self-report items, prompting participants to indicate the frequency they experience certain situations on a 4-point Likert Scale (0-3) over the preceding week. The HADS has two subscales, one that gauges symptoms of depression (HADS-D, e.g., “Worrying thoughts go through my mind”) and one that gauges symptoms of anxiety (HADS-A, e.g., “I get a sort of frightened feeling like 'butterflies' in the stomach”). The authors created this scale as a tool to assess depression and anxiety in people with health conditions. For example, it does not rely on somatic cues that may have more to do with other health conditions rather than depression or anxiety (i.e., fatigue, sleep disturbance). The scale has been demonstrated to have good psychometric properties (Bjelland, Dahl, Tangen, & Neckelmann, 2002).

The Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5;**Weathers et al., 2013)**. The PCL-5 is a 20-item self-report measure, which prompts participants to indicate the frequency with which they experience each PTSD symptom on a 5-point Likert scale (0-4) over the past month. This measure revised version of the previous PTSD checklist to reflect updates in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). As with the previous version, symptoms are summed to yield a continuous measure of PTSD symptom severity (Range: 0-80). Blevins, Weathers, Davis, Witte, and Domino (2015) reported excellent psychometric properties for this scale.

Program adherence. Participants were prompted to respond to 12 text messages over the course of six days. We calculated the total number of messages they responded to and divided this number by 12. In the final sample, participants completed 11.04 of scheduled texts out of 12 on average (*SD* =1.11).

Procedure

Screening. Initially, we screened participants over the phone (N = 38). We switched to an online prescreening survey, which was delivered using the Qualtrics.com platform. This screening determined eligibility for study participation based on the inclusion and exclusion criteria described above. Before the screening questions, participants agreed to the terms of a prescreening consent form either verbally (if the prescreening process was conducted over the phone) or with a digital signature (if the prescreening was conducted via Qualtrics.com).

Compensation. In exchange for completing the online surveys at T0, T1, T2, and T3, participants were entered into a raffle for one of four $100 Amazon gift cards. In addition, participants received a $10 gift card to Amazon.com for completing the final survey.

Random assignment. Participants were randomly assigned to one of three groups using the Microsoft Excel function "=RANDBETWEEN (1,3)." In the end, the distribution of the participants to the groups was as follows: High Mindfulness (N= 53), Low Mindfulness (N =48), and General Mindfulness (N = 55).

Baseline Measurement. After digitally signing an online consent form, all participants responded to an initial survey. The survey was comprised of the following scales and questions: Demographic questions (including questions about age, gender identity, marital status, religious beliefs, level of education, annual household income, employment status, and race/ethnicity), questions about pain history (including number of months the individual suffered from chronic

pain and the body areas they typically experience pain), the Pain Beliefs and Perceptions Inventory (Williams & Thorn, 1989), the Multidimensional Health Locus of Control Scale (Form C; Wallston et al., 1994), a Visual Analog Scale of pain intensity and unpleasantness, the Brief Pain Inventory, the MOS 36-Item Short-Form Health Survey (SF-36; (Ware et al., 1992), the Langer Mindfulness Scale (LMS-14; Pirson et al., 2012), the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983), the Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5; Blevins, Weathers, Davis, Witte, & Domino, 2015), and the Pain Catastrophizing Scale (PCS, Sullivan et al., 1995).

Experimental conditions. The independent variable was the degree to which we asked people to notice how their pain levels were changing over six days. We included three conditions in this experiment (i.e., "High Mindfulness Pain", "General Mindfulness": and "Low Mindfulness Pain"). Participants in all groups received two text message prompts every day for six days. The experimental conditions differed in the content of the text messages and the schedule they received the text messages. The differences among these conditions are detailed in the paragraphs below and in the schematics following them.

Condition 1 ("High Mindfulness Pain" group). We tailored the instructions for participants in this group in order to maximize the likelihood they would notice the variability in their pain sensations. For six consecutive days, we prompted participants in this condition to reflect on their pain twice per day (once in the morning and once in the late afternoon/early evening). The contact schedule was created separately for each participant using a random number generator with the parameters that the first message should be sent to the participant between 9am and noon and the second sent between noon and 9pm. Each communication asked participants to a) describe the activity they had been doing just before receiving our prompt, b)

rate their current pain levels on both severity and unpleasantness dimensions using a sliding scale version of the VAS with 0 indicating *No pain sensation (Not at all unpleasant)* and 100 indicating *Most intense pain imaginable* (*Most unpleasant imaginable*), and c) compare their pain levels to the last time we asked them using a sliding scale separately for intensity and unpleasantness (with -10 indicating *much more intense [or unpleasant] than last time*, 0 indicating *the same as last time* and 10 indicating *much more intense [or unpleasant] than last time*). In addition, this group was instructed each morning at 9am to be attentive to how their pain levels changed throughout the day and to ask oneself what might account for these changes, though we did not require any response to this prompt (see the text below):

Throughout the day, pay attention to the natural fluctuations in pain sensations. Pay attention to the effects these changes have on you and your behaviors and interactions with others throughout the day. Most importantly, notice when a symptom is better/worse and ask oneself why this may be. Notice three ways your symptoms are different from last time you checked."

Condition 2 ("General Mindfulness" group). Just like those in Condition 1, participants in Condition 2 were sent two text messages per day. Instead of receiving the messages on a random schedule, they received messages every day at the same times (i.e., one at 9am and one at 8pm). Those in this group were asked to reflect on the activity they had been engaged in just before receiving the prompt. We designed this group's instructions so that the participants were engaged in a mindfulness activity, without reference to pain. Specifically, in taking a moment to reflect on what they were doing, they were given the chance to become more engaged in the present moment.

Condition 3 ("Low Mindfulness Memory" group). This condition was designed to prompt participants to become aware of their pain levels, but not how symptoms were fluctuating. Participants in this condition received the same daily prompts asking them to report on their pain levels over the last 30 minutes, just as those in Condition 1. Unlike those in Condition 1, those in the Low Mindfulness Pain group were only prompted to report on their memory performance in the morning at 9am. Also unlike those in Condition 1, participants in Condition 3 were not asked to reflect on how their pain was fluctuating. Finally, participants in Condition 3 were also texted in the evening at 8pm, but this text message did not pertain to pain. This evening message prompted them to reflect on the activity they had been engaged in before receiving the text message prompt. The rationale for including this evening text message prompt was to ensure that all groups received two text-message prompts per day. We thought that prompting them about their pain severity twice per day could encourage them to notice fluctuation in their symptoms, which we did not want.

Table 2.3. Differences in text message scheduling among the three conditions.

	General Mindfulness	**Low Mindfulness**	**High Mindfulness**
2 daily text messages prompts?	Yes	Yes	Yes
Schedule of text messages	Fixed- 9am and 9pm	Fixed- 9am and9pm	Random - morning (9am-noon) and evening (noon-9pm)

Table 2.4. Difference in text message content Among three conditions.

	General Mindfulness	**Low Mindfulness Pain**	**High Mindfulness Pain**
Question about activities in last 30	Yes	Yes	Yes

minutes?			
Questions about pain in last 30 minutes?	No	Yes	Yes
Questions about how pain different from last timepoint?	No	No	Yes
Morning reminder to notice fluctuation in pain and consider underlying pattern?	No	No	Yes

Follow-up assessments. Regardless of condition, participants were contacted on a consistent schedule with follow-up surveys delivered via email. Specifically, we followed up with participants at three time points: on the day after the week's exercises (T1), one month after T1 (T2), and three months after T1 (T3). At T1, participants were asked to reflect on their impressions of the text messages. At the end of T3, participants saw a debriefing form[7]. If participants did not complete the final survey, we emailed them a copy of the final debriefing form.

Strategy for analyses. In order to determine the effects of our interventions on our dependent variables of interest, we first conducted a series of one-way ANCOVAs, inserting the baseline scores of each dependent variable as covariates. Before running these tests, we checked that statistical assumptions of the one-way ANCOVA were met for each of our dependent variables, as follows:

[7] Note that for this dissertation, only results at T1 are reported.

1) First, we checked for the homogeneity of regression means, separately for each dependent measure of interest, by inspecting the Condition x Baseline term of the ANCOVA analyses. We found that each of our measures satisfied this assumption, except Pain Interference (see Appendix B), so we opted for an ANOVA rather than an ANCOVA in that case.
2) Second, we checked to make sure the data satisfied the assumption of homogeneity of variances across the experimental conditions by using Levene's Test of Equality of Error Variances. All measures except PBAPI's "Pain as Mystery" and MHLC "Chance" met this assumption (see Appendix B). In the case of "Pain as Mystery" and "Chance" we utilized a reciprocal transformation, and the error variances were equally distributed after this transformation (Figures 2.3 and 2.6).
3) Third, we checked for outliers via visual inspection of the boxplots. Outliers were defined as those with standardized residuals with *z*-scores above or below 3. We utilized a winsorizing procedure on any outliers, which are discussed in the results section below (see Appendix B).

Given our data were not amenable to repeated measures ANOVAs (as we tested participants at only two time points), we decided to further investigate the difference between baseline and follow-up sessions by conducting a series of paired-sample t-tests, separately for each of the three study conditions. Given concerns about multiple comparisons and increased chances of a Type I Error, we applied a Bonferroni correction to these analyses, dividing the significance value (.05) by the number of tests performed (3) for a more conservative significance value of .017. In the cases of the High Mindfulness Pain group, we had a priori predictions about the direction of the effect, so our significance value was set to .1, and adjusted

to .033 with the Bonferroni correction. Each of the dependent variables met the statistical assumptions of this test.

3.6 Results for study 2

In this section, we begin with a summary of the most notable findings, and then describe the results in detail for of our four separate research questions, which investigated the effects of the interventions on 1) beliefs about pain, 2) pain interference, 3) pain severity, and 4) pain catastrophizing.

Summary of findings

Paying attention to the variability in the pain experience (the "High Mindfulness Pain" group) resulted in positive changes after the intervention including significant decreases in reports of pain interfering in their daily lives (p =.03). As expected, the ATV intervention also resulted in decreased likelihood of endorsing "Pain as Permanent" (p = .001). In term of locus of control, ATV participants increased their endorsement of a doctor's role in their treatment (p =.006).

Paying attention to pain (the "Low Mindfulness Pain" group) resulted in positive cognitive changes, including decreased magnification of pain (p =.037). The group also evidenced some changes in pain beliefs, including significantly more endorsement of a doctor's role in their treatment (p = .015) and marginally increased endorsement of the role of chance/fate in the pain experience (p =.065).

Finally, we saw significant relationships between trait mindfulness measured by scores on the LMS and mental health variables. We discovered a negative relationship between trait mindfulness the following measures: depressive symptoms (r = -.26, p = .001), PTSD symptoms

(-.19, p = .018), pain magnification (r = -.17, p = .03), attitudes of helplessness towards pain (r = -.18, p = .02), and beliefs of pain as mysterious (r = -.19, p = .02). The LMS was also positively correlated with attitudes towards the doctor's role in the treatment process (r = .20, p = .02). See below for the full analysis, parsed by research question.

Demographic variables

First we tested to ensure that the experimental groups did not significantly differ on the demographic variable of age and following pain-related variables: Pain Duration (in months) and "usual level of pain" on a scale of 0-10 (Pain Severity). For the descriptive statistics of these variables across the conditions see Appendix B.

A one-way ANOVA revealed no significant difference in the age of our participants among the three conditions (F(2, 153) = .80, p = .45).. Similarly, a one-way ANOVA revealed no statistically significant difference among the three conditions in their reported pain duration (F(2, 153) = 2.68, p = .07) or "usual" level of pain severity (F(2, 153) = .50, p = .61). See Appendix B for the full analyses.

Research question #1: Pain beliefs

Our first research question concerned the effects of our interventions on pain beliefs. This question had two parts:

1) Does paying attention to variability in pain experience positively affect how much control someone feels (s)he has over their pain?
2) Does paying attention to variability in pain experience affect how someone views his/her pain (i.e., as permanent, constant, or mysterious)?

In order to answer the first question, we conducted a series of one-way ANCOVAs to examine whether there were statistically significant differences in how much control one feels

they have over their pain among the three study conditions after our intervention (T1), adjusting for the effect of baseline scores. After checking that the statistical assumptions were met, we conducted separate ANCOVA analyses for the following subscales of the Multidimensional Health Locus of Control-Form C: Doctors, Chance, and Internal. We were missing a question from the "Other People" subscale, so we were not able to analyze it. In order to answer the second question, we also conducted separate ANCOVA analyses for the following Pain Beliefs and Perceptions Inventory (PBAPI) subscales: Pain as Permanent, Pain as Constant, Pain as Mystery, and Self-Blame.

MHLC-Doctors. A one-way ANOVA revealed that there were no significant differences among the three group means at baseline, $F(2, 153) = .14$, $p = .87$ (see Appendix B).

Next we conducted our primary analysis, a one-way ANCOVA, which revealed the following results: As expected, the covariate (scores at baseline) was significantly related to the follow-up scores ($F(1,152) = 112.82$, $p < .001$, partial $\eta^2 = .43$; see Appendix B). After adjusting for pre-intervention scores of MHLC-Doctors, there was not a statistically significant difference in post-intervention scores of MHLC-Doctors among the three conditions, $F(2, 152) = 1.20$, $p = .30$, partial $\eta^2 = .02$. See the graphical depiction of the Estimated Marginal Means of the three conditions at T1 just below.

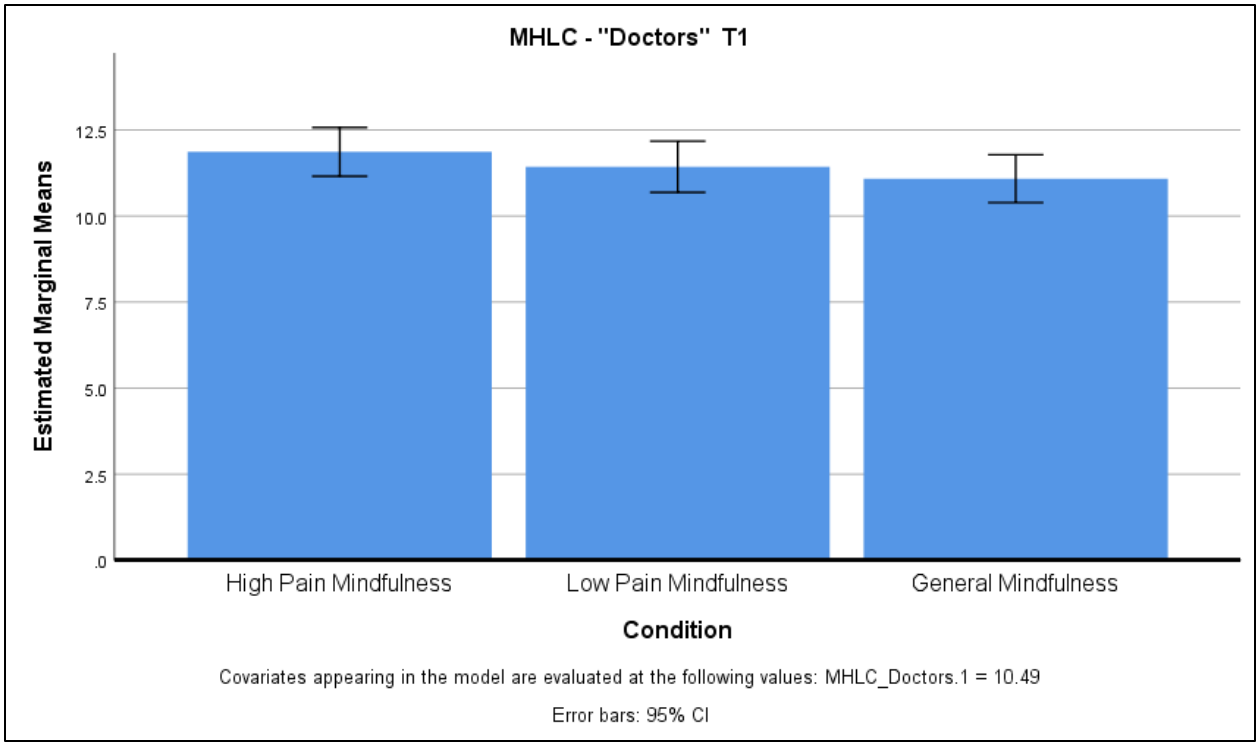

Figure 2.5. Estimated Marginal Means for MHLC- "Doctors" at T1. The error bars indicate a 95% confidence interval.

Paired-sample t-tests revealed the following: Participants' mean "MHLC-Doctors" score significantly increased for both the High Mindfulness Pain group ($M_{Baseline}$ = 10.28 [SD = 3.77], M_{Final} = 11.74 [SD = 3.52], $t(52) = -2.86$, $p = .006$) and for Low Mindfulness Pain group, ($M_{Baseline}$ = 10.65 [SD = 3.81], M_{Final} =11.52 [SD = 3.38]), $t(47) = -2.52$, $p = .015$. Finally, for those in the General Mindfulness group, the mean "MHLC-Doctors" score did not change significantly from baseline to follow-up, $t(54) = -1.56$, $p = .12$.

MHLC-Chance. A one-way ANOVA revealed that there were no significant differences among the three group means on MHLC-Chance scores at baseline, $F(2, 153) = .52$, p = .59 (see Appendix B).

Next we conducted our primary analysis, a one-way ANCOVA, which revealed the following: As expected, the covariate (scores at baseline) was significantly related to the follow-up scores ($F(1,152) = 100.43$, $p < .001$, partial $\eta^2 = .40$; see Appendix B). After adjusting for pre-intervention scores of MHLC-Chance, there was not a statistically significant difference in post-intervention scores of MHLC-Chance among the three conditions, $F(2, 152) = .73$, $p = .48$, partial $\eta^2 = .01$.

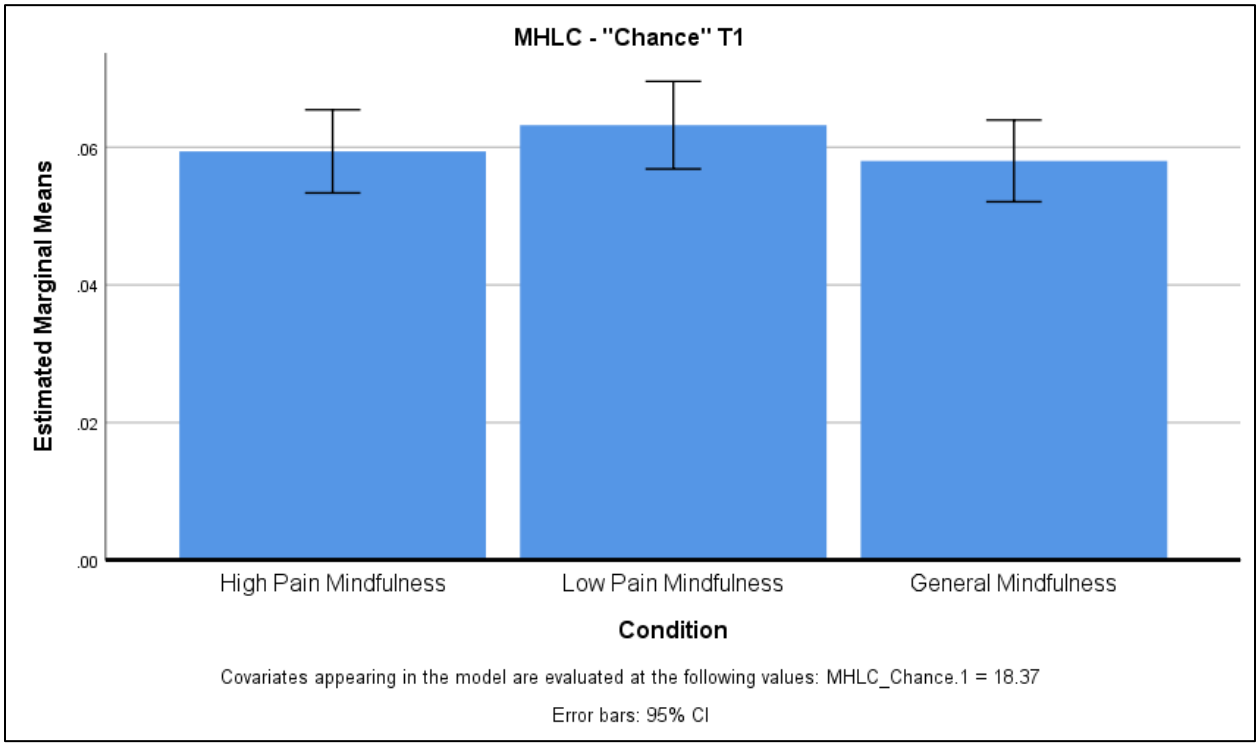

Figure 2.6. Estimated Marginal Means for MHLC- "Chance" at T1. The error bars indicate a 95% confidence interval.

Paired-sample t-tests revealed the following: For those in the Low Mindfulness Pain group, the mean "MHLC-Chance" score marginally increased from baseline ($M = 17.58$, $SD = 7.11$) to follow-up ($M = 18.65$, $SD = 7.13$), $t(47) = -1.88$, $p = .065$. Participants' mean "MHLC-

Chance" score did not significantly change from baseline to follow-up for either the High Mindfulness Pain group ($t(52) = -1.31$, $p = .20$) nor for the General Mindfulness group, $t(54) = -1.52$, $p = .14$.

MHLC-Internal. We did not find a significant effect of any of our interventions on the MHLC-Internal scores. For the full analysis, see Appendix B. See the graphical depiction of estimated marginal means at T1 just below.

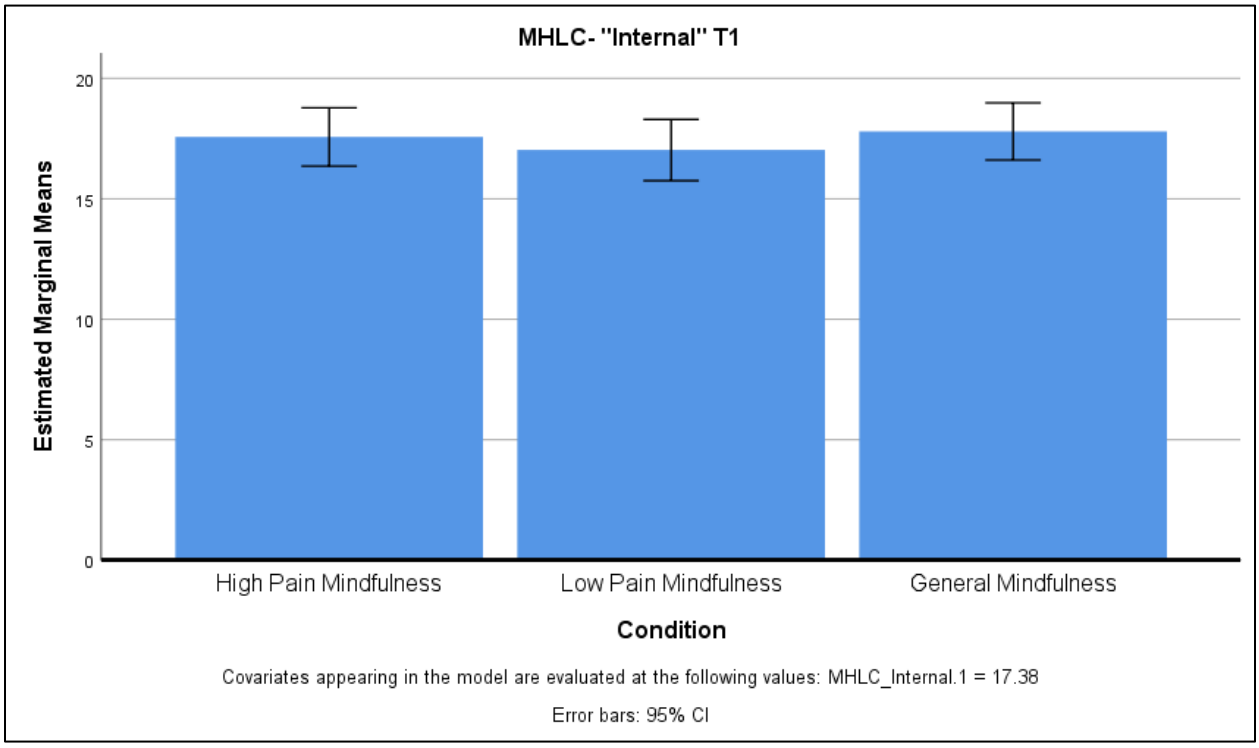

Figure 2.7. Estimated Marginal Means for MHLC- "Internal" at T1. The error bars indicate a 95% confidence interval.

PBAPI- Pain as Permanent. We identified two outliers in this dependent variable and applied a winsorizing transformation procedure (see Appendix B). A one-way ANOVA revealed

that there were no significant differences among the three group means on “Pain as Permanent” scores at baseline, $F(2, 153) = .16$, $p = .85$ (see Appendix B).

Next we conducted our primary analysis, a one-way ANCOVA to determine if there were differences in “Pain as Permanent” scores at T1 among the three study conditions, after taking into account the baseline measures. As expected, the covariate (“Pain as Permanent” scores at baseline) was significantly related to the final “Pain as Permanent” scores ($F(1,152) = 262.84$, $p < .001$, partial $\eta^2 = .63$; see Appendix B). After adjusting for pre-intervention scores of the measure, we found a statistically significant difference in post-intervention scores of “Pain as Permanent” among the three conditions, $F(2, 152) = 3.522$, $p = .032$, partial $\eta^2 = .044$. See the graphical depiction of estimated marginal means at T1 just below.

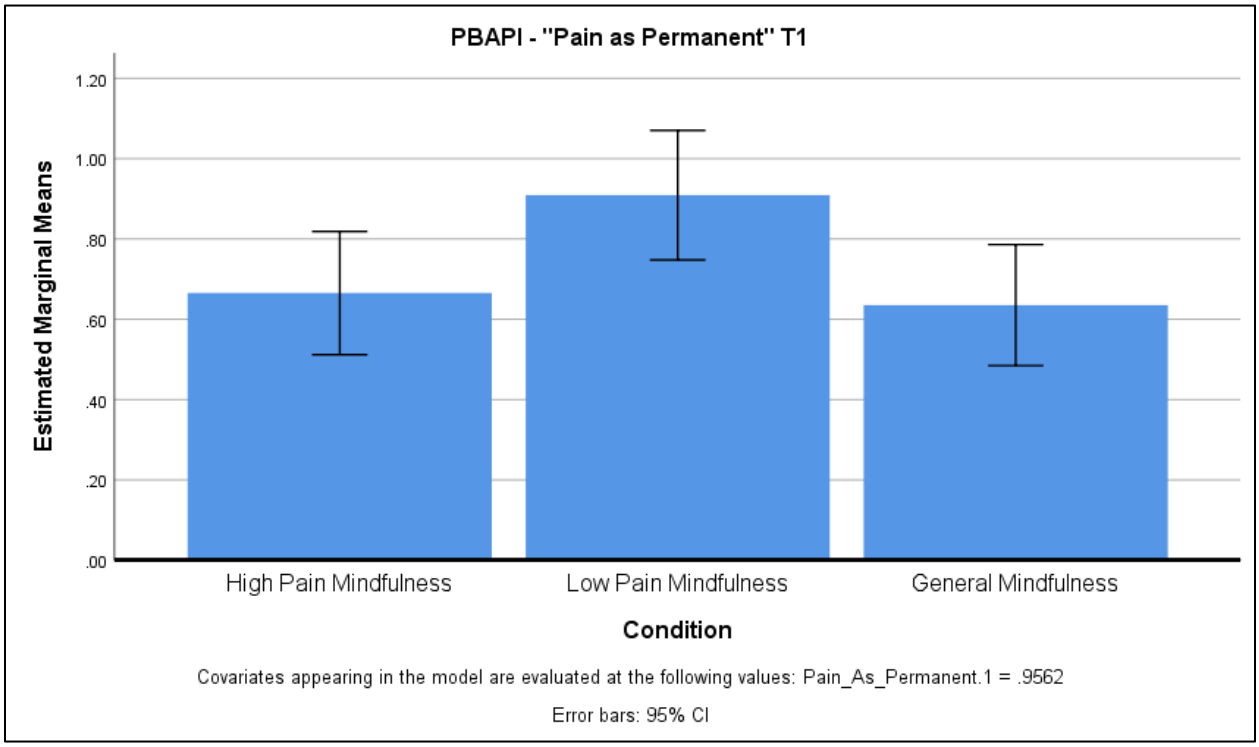

Figure 2.8. Estimated Marginal Means for PBAPI- "Pain as Permanent" at T1. The error bars indicate a 95% confidence interval.

Pairwise comparisons on the Estimated Marginal Means were conducted with a Bonferroni correction (see Figure 13.5). "Pain as Permanent" scores at follow-up were statistically significantly higher in the Low Mindfulness Pain condition (M = .91, SE = .08) than in the General Mindfulness condition (M = .64, SE = .08), a mean difference of .27, 95% CI [-.029-.517], p = .046. There was no significant difference between the High Mindfulness Pain and Low Mindfulness Pain groups (p = .1), nor was there a significant difference between the High Mindfulness Pain group and the General Mindfulness group (p = 1.0).

Paired-sample t-tests revealed the following: Participants' mean score significantly decreased on "Pain as Permanent" for the High Mindfulness Pain group ($M_{Baseline}$ = .96 [SD = .86] at T .67 (SD = .95) at T1, $t(52) = 3.68$, p = .001). Similarly, for those in the General Mindfulness group, the mean score significantly decreased from .91 (SD = .91) at T0 to .60 (SD = .90) at T1, t (55) = 3.50, p =.001. For those in the Low Mindfulness Pain group, the mean score did not change significantly from baseline (M = 1.01, SD = .96) to follow-up (M = .95, SD = .94; $t(47)$= .78, p= .44).

PBAPI –Pain as Mystery. Our analyses did not reveal any effects of the intervention on this variable. For a full description of the analyses, see Appendix B. See the graphical depiction of estimated marginal means at T1 just below.

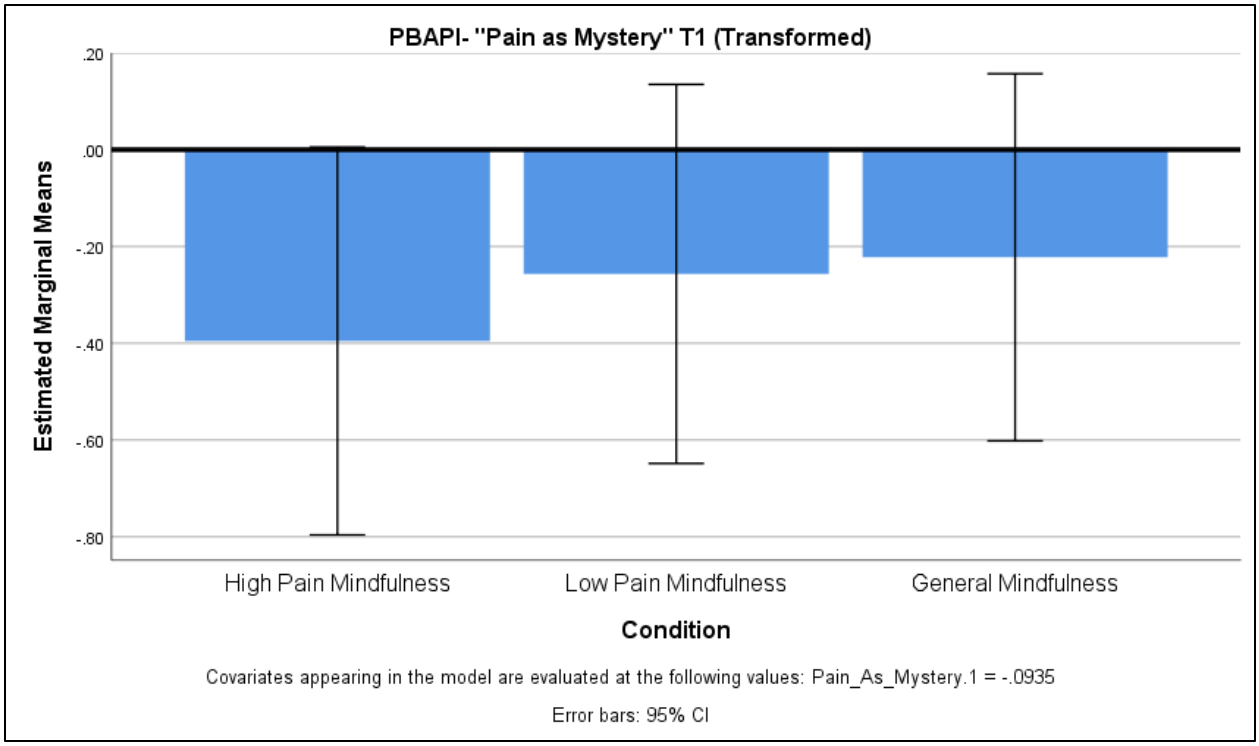

Figure 2.9. Estimated Marginal Means for PBAPI- "Pain as Mystery" at T1. The error bars indicate a 95% confidence interval.

PBAPI- Pain as Constant. A one-way ANOVA revealed that there were no significant differences among the three group means on "Pain as Constant" scores at baseline, $F(2, 153) = .06$, $p = .95$ (see Appendix B).

Next we conducted our primary analysis, a one-way ANCOVA to determine if there were differences in "Pain as Constant" scores at T1 among the three experimental study conditions, taking into account the baseline scores. As expected, the covariate ("Pain as Constant" scores at baseline) was significantly related to the follow-up "Pain as Constant" scores ($F(1,152) = 150.12$, $p < .001$, partial $\eta^2 = .50$; see Appendix B). After adjusting for pre-intervention scores of the measure, there was not a statistically significant difference in post-intervention scores among

the three conditions, $F(2, 152) = .19$, $p = .83$, partial $\eta^2 = .002$ (Appendix B). See just below for a graphical depiction of the estimated marginal means of the three conditions at follow-up.

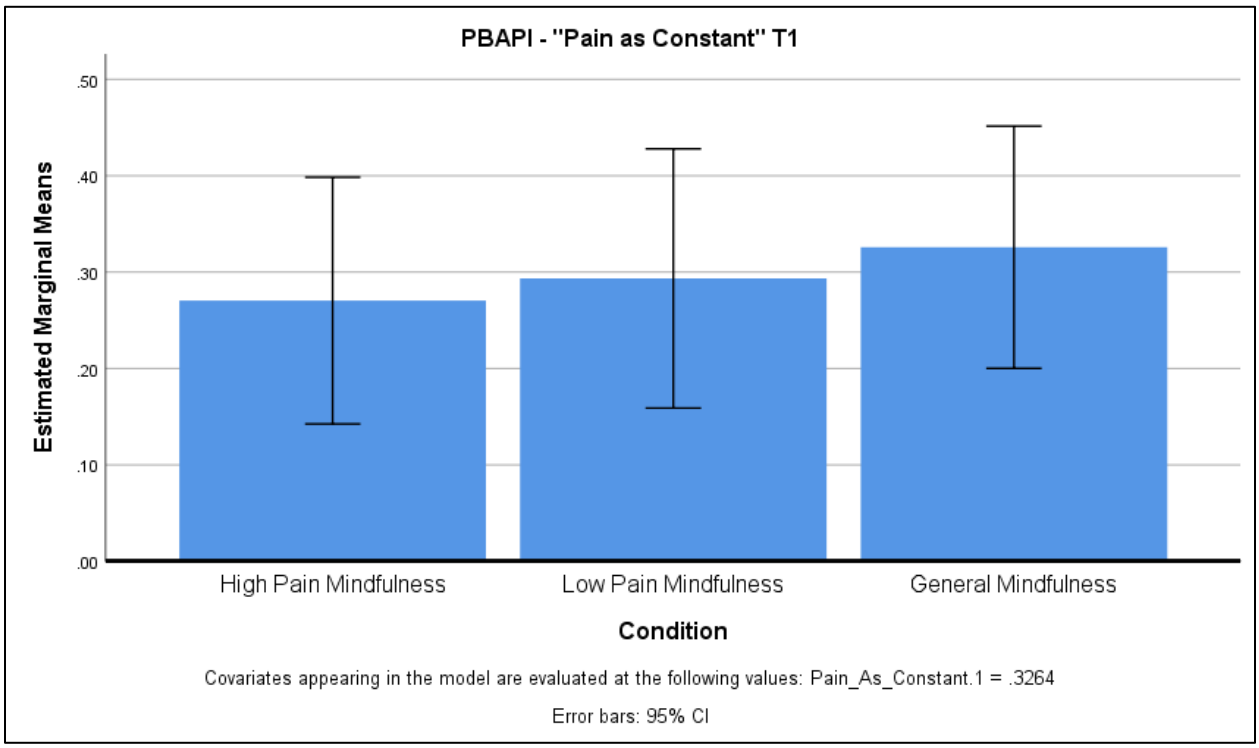

Figure 2.10. Estimated Marginal Means for PBAPI- "Pain as Contant" at T1. The error bars indicate a 95% confidence interval.

Paired-sample t-test revealed the following: Participants' mean score did not change between baseline and follow for any of the groups (High Mindfulness Pain: $t(52) = .78$, $p = .44$; Low Mindfulness Pain: $t(47) = .44$, $p = .66$; General Mindfulness: $t(54) = .08$, $p = .94$).

PBAPI- Self-Blame. A one-way ANOVA revealed that there were no significant differences among the three group means on "Self-Blame" scores at baseline, $F(2, 153) = 1,12$, $p = .33$ (see Appendix B).

Next we conducted our primary analysis, a one-way ANCOVA to determine if there were differences in final "Self-Blame" scores among the three study conditions, taking into account the baseline scores. As expected, the covariate ("Self-Blame" scores at baseline) was significantly related to the follow-up "Self-Blame" scores, ($F(1,152) = 196.27$, $p < .001$, partial $\eta^2 = .56$; see Appendix B). After adjusting for pre-intervention scores of the measure, there was not a statistically significant difference in post-intervention scores among the three conditions, $F(2, 152) = 1.69$, $p = .19$, partial $\eta^2 = .022$ (Appendix B). See just below for a graphical depiction of the estimated marginal means of the three conditions at follow-up.

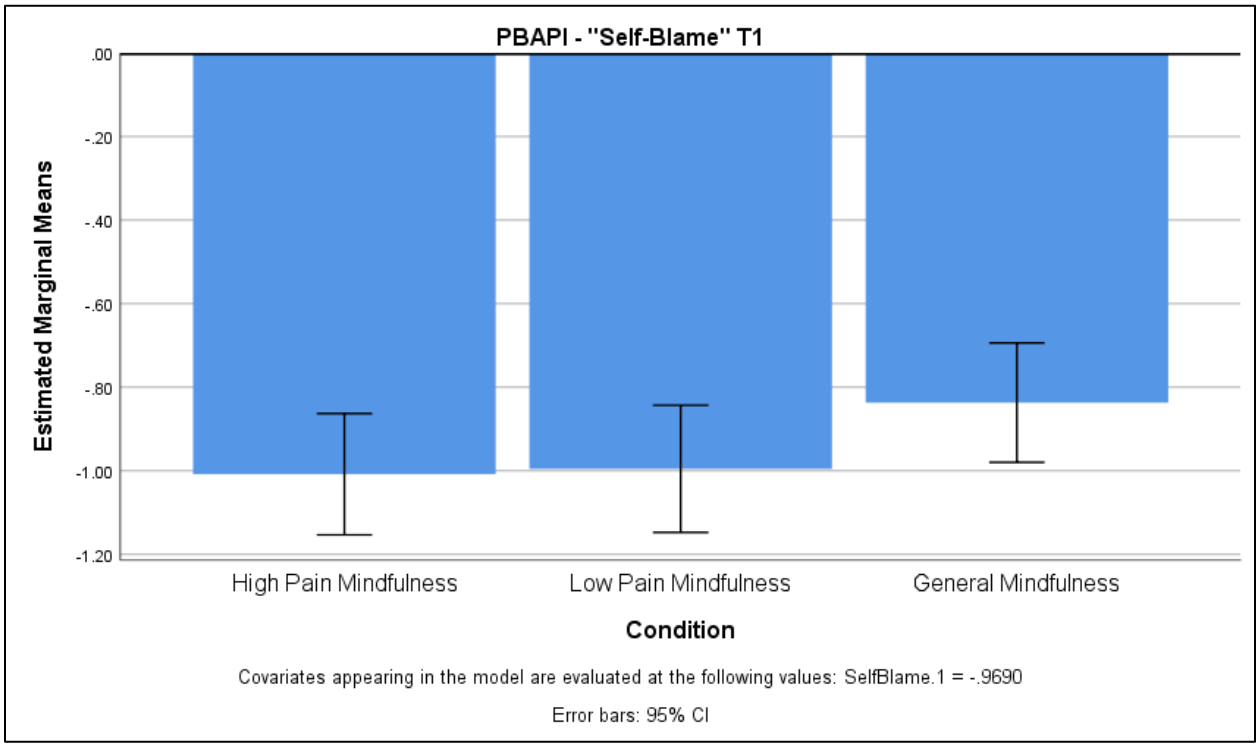

Figure 2.11. Estimated Marginal Means for PBAPI- "Pain as Constant" at T1. The error bars indicate a 95% confidence interval.

Paired-sample t-tests revealed the following: For those in the General Mindfulness group, the mean score increased baseline ($M = -1.1$, $SD = .74$) to follow-up ($M = -.93$, $SD = .87$;

$t(54)= -2.24$, $p= .03$). Participants' mean scores did not significantly change from baseline to follow-up for either the High Mindfulness Pain group ($t(52) = .86$, $p = .39$) or the Low Mindfulness Pain group ($t\ (47) = .41$, $p = .68$).

Research question #2: Pain interference

Our second research question of interest was: Does paying attention to variability in pain result in improvements in how much pain affects one's day-to-day life (i.e., reduced pain interference as measured by the MOS SF-36)?

First, we checked that we had met the statistical assumptions of the ANCOVA (see above for the preliminary analyses). In fact, the data for this measure violated an important statistical assumption of the ANCOVA: the homogeneity of regression slopes (Appendix B). As a result, we conducted a one-way ANOVA on the final pain interference scores, without accounting for the baseline scores. A one-way ANOVA revealed that there were no significant differences among the three group means on pain interference scores at baseline, $F(2, 153) = 1.45$, $p = .24$ (Appendix B). We found no significant effect of experimental condition on the final scores, $F(2, 153) = .28$, $p = .76$ (Appendix B). See just below for a graphical depiction of the estimated marginal means of the three conditions at follow-up.

Paired-sample t-tests revealed the following: For the High Mindfulness Pain group, participants' mean score significantly decreased from 7.03 ($SD = 2.11$) at baseline to 6.46 ($SD = 2.52$) at follow-up, $t(52) = 2.23$, $p = .03$. Participants' mean score did not change between baseline and follow-up for the Low Mindfulness Pain group $(t(47) = .19, p = .85)$ or for the General Mindfulness Group ($t(54)= .74$, $p= .46$).

Research question #3: Pain severity

Our third research question of interest was: Does paying attention to variability in pain experience positively affect pain severity? We answered this question by investigating two questions on the Brief Pain Inventory. The first question asked participants to rate their pain on average: "Please rate your pain by marking the box beside the number that best describes your pain on average (0 = *no pain* and 10 = *pain as bad as you can imagine*)." The second question asked participants to rate their pain at that moment: "Please rate your pain by marking the box beside the number that tells how much pain you have right now (0 = *no pain* and 10 = *pain as bad as you can imagine*)."

BPI – "Pain on Average". A one-way ANOVA revealed that there were no significant differences among the three group means on "Pain on Average" scores at baseline, $F(2, 153) = .26$, $p = .77$ (see Appendix B).

Next we conducted our primary analysis, a one-way ANCOVA to determine if there were differences in "Pain on Average" scores at T1 among the three study conditions, accounting for baseline measures. As expected, the covariate ("Pain on Average" scores at baseline) was significantly related to the follow-up "Pain on Average" scores ($F(1,152) = 49.26$, $p < .001$, partial $\eta^2 = .25$; see Appendix B). After adjusting for pre-intervention scores of the measure, there was not a statistically significant difference in post-intervention scores among the three conditions, $F(2, 152) = .263$, $p = .77$, partial $\eta^2 = .003$ (Appendix B). See just below for a graphical depiction of the estimated marginal means of the three conditions at follow-up.

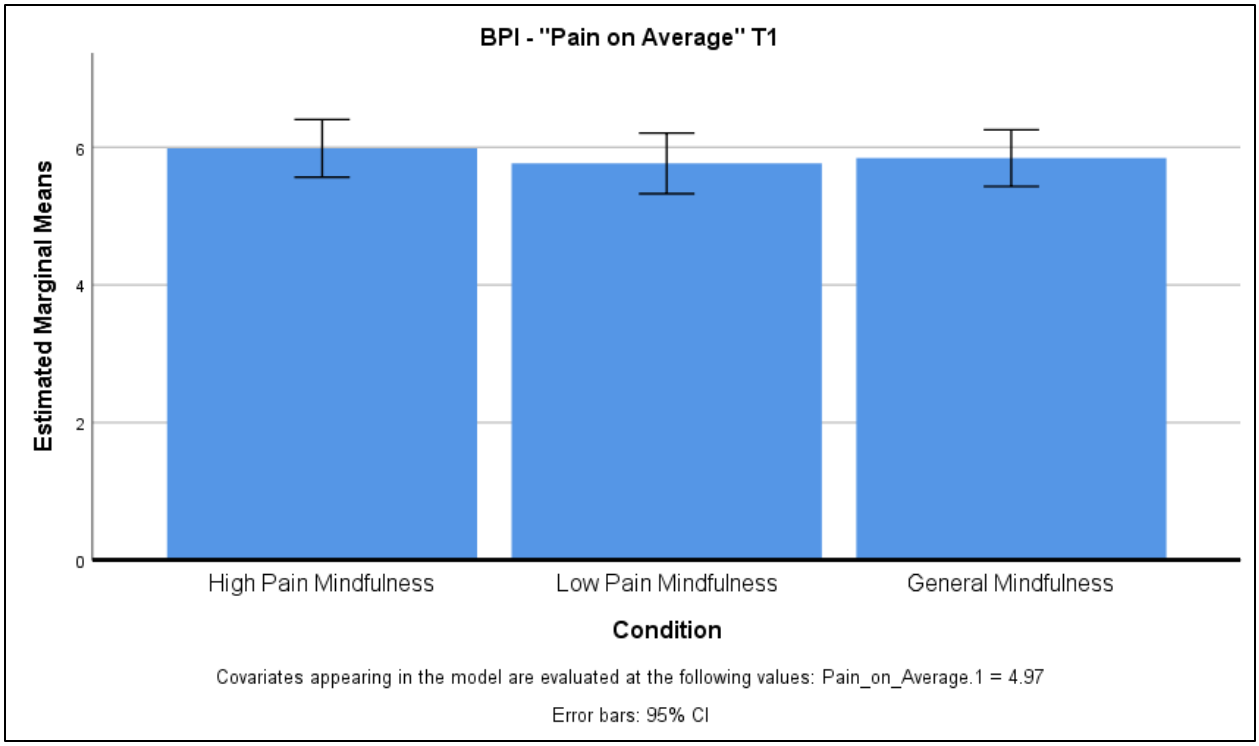

Figure 2.11. Estimated Marginal Means for BPI- "Pain on Average" at T1. The error bars indicate a 95% confidence interval.

Paired t-tests revealed that all three groups increased significantly on reported pain severity (High Mindfulness Pain group: $M_{Baseline}$ = 4.89 [*SD* = 1.80] , M_{Final} = 5.94 [*SD* = 1.84], *t*(52) = -4.30, *p* < .001; Low Mindfulness Pain group: $M_{Baseline}$= 4.90 [*SD* = 1.89], M_{Final}= 5.73 [*SD* = 1.62], *t*(47) = -3.67, *p* =.001; General Mindfulness group, $M_{Baseline}$ = 5.13 [*SD* = 2.17], M_{Final} = 5.91, [*SD* = 1.82]; *t*(54)= -2.65, *p*= .011).

BPI - "Pain Right Now". Our analyses did not reveal any effects of the intervention on this variable. For a full description of the analyses, see Appendix B. See just below for a graphical depiction of the estimated marginal means of the three conditions at follow-up.

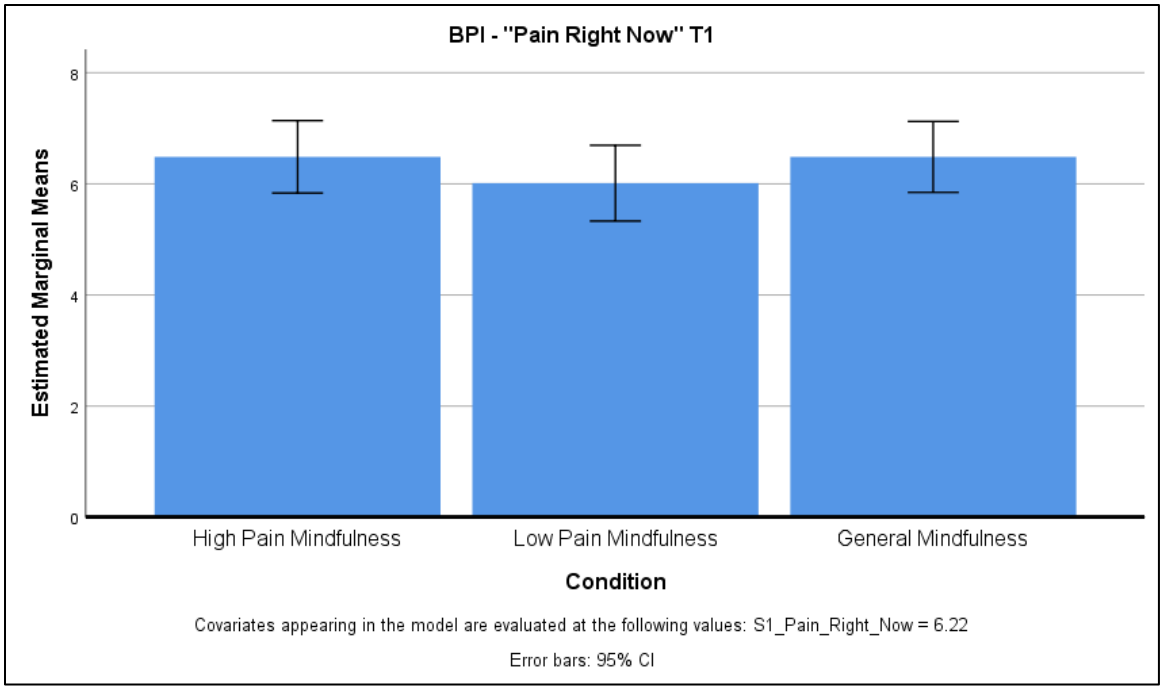

Figure 2.12. Estimated Marginal Means for BPI- "Pain Right Now" at T1. The error bars indicate a 95% confidence interval.

Research question #4: Pain catastrophizing

Our final research question of interest was: Does paying attention to variability in pain experience positively affect the extent to which someone reports pain catastrophizing*?*

We conducted one-way ANCOVAs to examine whether there were significant differences in Pain Catastrophizing Scale scores among the three study conditions at follow-up (T1). Specifically, we did separate analyses for each of the subscales of the Pain Catastrophizing Scale including: Rumination, Magnification, and Helplessness.

PCS-Magnification. A one-way ANOVA revealed that there were no significant differences among the three group means on "Magnification" scores at baseline, $F(2, 153) = 1.27$, $p = .28$ (see Appendix B).

Next we conducted our primary analysis, a one-way ANCOVA to determine if there were differences in "Magnification" scores at T1 among the three study conditions, accounting for baseline scores. The covariate (scores at baseline) was significantly related to the follow-up scores ($F(1,152) = 189.08$, $p < .001$, partial $\eta^2 = .55$; see Appendix B). After adjusting for pre-intervention scores of the measure, there was a statistically significant difference in post-intervention scores among the three conditions, $F(2, 152) = 4.14$, $p = .018$, partial $\eta^2 = .052$ (Appendix B). See just below for a graphical depiction of the estimated marginal means of the three conditions at follow-up.

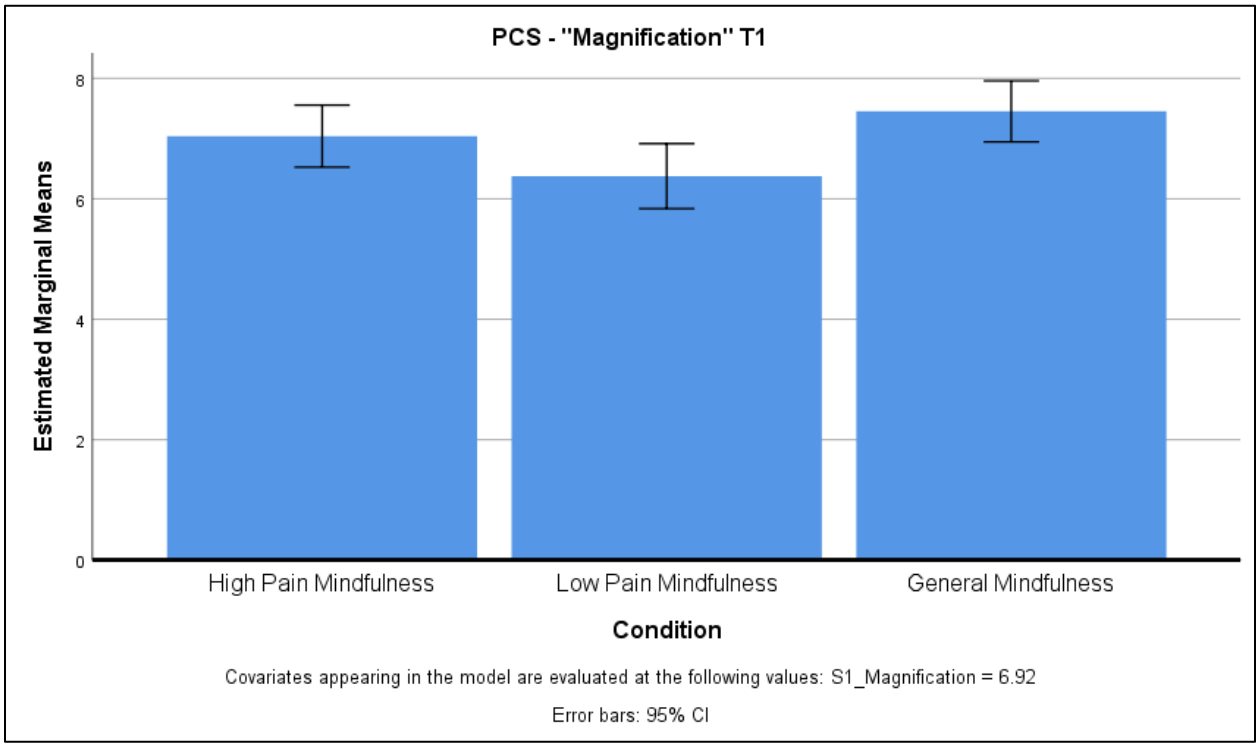

Figure 2.13. Estimated Marginal Means for PCS-Magnification at T1. The error bars indicate a 95% confidence interval.

Pairwise comparisons on the Estimates Marginal Means were conducted with a Bonferroni correction (Appendix B). "Magnification" scores at follow-up were statistically

significantly higher in the General Mindfulness condition (M = 7.45, SE = .26) than in the Low Mindfulness Pain condition (M = 6.38, SE = .27), a mean difference of 1.07, 95% CI [.166, 1.984], p = .046. There was no significant difference between the High Mindfulness Pain and Low Mindfulness Pain groups (p = .24), nor was there a significant difference between the High Mindfulness Pain group or the General Mindfulness group (p = .37).

Paired t-tests revealed the following: For the General Mindfulness condition, participants' mean score significantly increased from 6.42 (SD = 2.83) at T0 to 7.09 (SD = 2.80) at T1, $t(54) = -2.72$, p = .009. For those in the Low Mindfulness Pain condition, the mean score decreased from baseline (M = 7.13, SD = 3.28) to follow-up (M = 6.52, SD = 2.64; $t(47) = 2.14$, p= .037). Finally, for those in the High Mindfulness Pain condition, the mean score did not change significantly from baseline to follow-up ($t(52) = -.06$, p= .95).

PCS-Rumination. A one-way ANOVA revealed that there were no significant differences among the three group means on "Rumination" scores at baseline, $F(2, 153) = 2.58$, p = .08 (see Appendix B).

Next we conducted our primary analysis, a one-way ANCOVA to determine if there were differences in "Rumination" scores at T1 among the three study conditions, after taking the baseline scores into account. As expected, the covariate ("Rumination" scores at baseline) was significantly related to the follow-up "Rumination" scores ($F(1,152) = 167.02$, $p < .001$, partial $\eta^2 = .52$; see Appendix B). After adjusting for pre-intervention scores of the measure, there was not a statistically significant difference in post-intervention scores among the three conditions, $F(2, 152) = 2.81$, p = .06, partial $\eta^2 = .036$ (Appendix B). See just below for a graphical depiction of the estimated marginal means of the three conditions at follow-up.

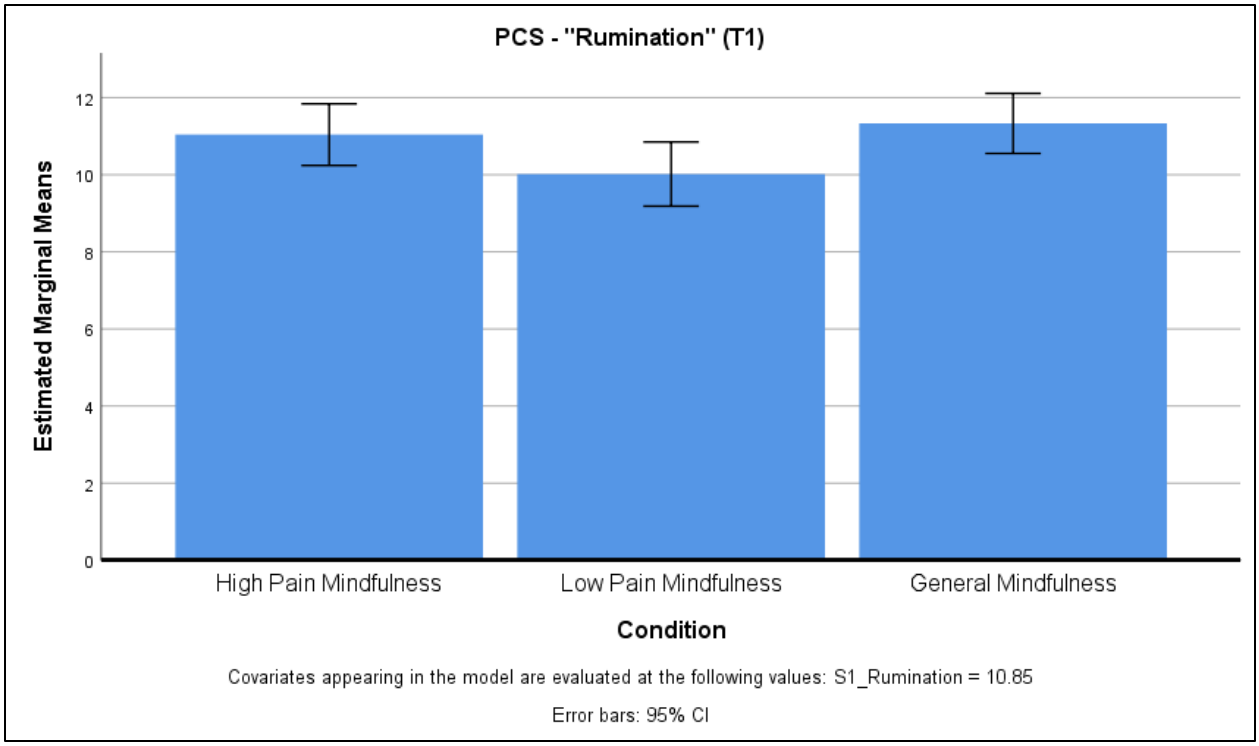

Figure 2.13. Estimated Marginal Means for PCS-Rumination at T1. The error bars indicate a 95% confidence interval.

Paired-sample t-tests revealed that none of the groups significantly changed from baseline to follow-up (High Mindfulness Pain group: $t(52) = .22$, $p = .83$; Low Mindfulness Pain group: $t(47) = 1.71$, $p = .09$; General Mindfulness group: $t(54) = -1.65$, $p = .10$).

PCS-Helplessness. Our analyses did not reveal any effects of the intervention on this variable. For a full description of the analyses, see Appendix B.

Research question #5: Trait Mindfulness

Finally, we probed the relationship between trait mindfulness (as measured by the Langer Mindfulness Scale) and pain-related outcomes, by calculating Pearson correlation coefficients. We saw significant relationships between trait mindfulness measured by scores on the LMS and mental health variables. We discovered a significant negative relationship between trait

mindfulness the following measures: depressive symptoms (r = -.26, p = .001) and PTSD symptoms (r =-.19, p = .018). In the same vein, we observed a marginally significant negative relationship between the LMS and Anxiety symptoms (r =-.16, p = .066). We also observed a significant negative relationship between the LMS and the following pain catastrophizing measures and pain beliefs: pain magnification (r = -.17, , p = .03), attitudes of helplessness towards pain (r = -.18, , p = .02), and beliefs of pain as mysterious (r = -.19, p = .02). There was also a marginally significant negative relationship between the LMS and pain rumination (r = -.14, p = .07). The LMS was also positively correlated with attitudes towards the doctor's role in the treatment process (r = .20, p = .02). Finally, we did not observe a relationship between the LMS and the following measures at baseline: ratings of pain on average (r = .02, p = .78), ratings of pain "right now" (r = -.09, p = .26), pain interference scores (r = -.12, p = .13), beliefs about internal locus of control, (r = -.07, p = .41), blaming the self for the pain (r = -.13, p = .10), beliefs about the role of chance/fate in the pain experience (r = -.10, p = .22), beliefs about pain as constant (r = .007, p = .93), and beliefs about pain as permanent (r = .031, p = .70).

As an exploratory analysis, we conducted a series of Pearson's Chi-square tests to determine if whether or not a person improved depended on his/her level of trait mindfulness. To explore this, we tested whether those scoring in the top 25% of the LMS had a higher likelihood of improving on our outcomes of interest than those scoring in the bottom 25%. We found that the likelihood of improving on the "helplessness" measure was higher in top LMS performers, $\chi^2(1, N = 66) = 3.48$, p = 0.06 (see Appendix B). The rest of the tests did not reveal a significant effect of LMS quartile on whether an individual improved (see Appendix B). We also conducted an exploratory analysis investigating the effect of decreasing one's belief that pain is constant on improvement in other areas. We found an effect of changing one's belief about one's personal

control and one's reports of "pain right now". Specifically, we found that the participants who became less likely to endorse their pain is constant increased on perceived personal control over the pain ($\chi^2(1, N = 46) = 4.81, p = 0.028$) and decreased on ratings of pain right now ($\chi^2(1, N = 40) = 3.06, p = 0.084$)[8]. See Appendix B.

3.7 Discussion

With one in five adults worldwide experiencing the effects of chronic pain, it is essential to understand how to mitigate its effects (Gureje, Korff, Simon, & Gater, 1998). Given that pain is defined by the psychological interpretation of noxious stimuli, we determined that intervening on this process of interpretation could be particularly useful. Specifically, we intervened on the attentional proecss, as it is yet unclear under what circumstances it is more adaptive to attend to the pain or distract oneself from it.

In the present study, we tested an "attention to variability" (ATV) paradigm with chronic pain patients (N=156). Specifically, we investigated how prompting participants to pay attention to the fluctuation in their pain sensations would affect their pain experience including: beliefs about pain, subjective ratings of the pain, how much they felt that the pain affected their daily lives, and reports of pain catastrophizing. In order to test the ATV effects, we created a text-message-based intervention, which consisted of three text messages every day for six days. We included two comparison groups that also received six days of text-message prompts: 1) a group that was asked to pay attention to their pain, but not the fluctuations ("Low Mindfulness Pain"), and 2) a group that was asked to report on the activity they were engaged in over the past 30 minutes ("General Mindfulness").

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[8] This finding was considered significant with our one-tailed predictions.

Summary of findings. Paying attention to the variability in the pain experience (the "High Mindfulness Pain" group) resulted in positive changes after the intervention including significant decreases in reports of pain interfering in their daily lives (p =.03). As expected, the ATV intervention also resulted in decreased likelihood of endorsing "Pain as Permanent" (p = .001). In terms of locus of control, ATV participants increased their appreciation for communicating with one's doctor (p =.006).

Paying attention to pain, but not the fluctuations (the "Low Mindfulness Pain" group) resulted in adaptive cognitive changes, including decreased magnification of pain (p =.037). The group also evidenced some changes in pain beliefs, including significantly more endorsement of a doctor's role in their treatment (p = .015) and marginally increased endorsement of the role of chance/fate in the pain experience (p =.065). Finally, they were also significantly more likely than those in the General Mindfulness group to endorse pain as "permanent" (p =.065). These findings suggest that emphasizing the predictability of pain can have positive effects.

The General Mindfulness group evidenced maladaptive changes after the intervention including: significant increases in pain magnification (p = .009) and a higher likelihood towards self-blame after the intervention than before (p= .03). In terms of pain beliefs, they decreased significantly on the "Pain as Permanent" measure (p =.001), and were significantly lower on this measure than the "Low Mindfulness Pain" group at follow-up, controlling for baseline scores (p = .046). One reason we may have seen an increase in self-blame in this group is that the text-messages which prompted people report their activities over the past 30 minutes emphasizes active behavior (as discussed in Chapter 2). While the other two groups were also asked to report on their activities, it was not the sole focus of the text message prompts. It is also difficult to

interpret whether "self-blame" should be interpreted as a negative or positive, as endorsement of these statements could be evidence of more internal control.

Finally, we saw significant relationships between trait mindfulness measured by scores on the LMS and mental health variables in the predicted directions. We found a negative relationship between trait mindfulness the following measures: depressive symptoms (r = -.26, p = .001), PTSD symptoms (-.19, p = .018), pain magnification (r = -.17, p = .03), attitudes of helplessness towards pain (r = -.18, p = .02), and beliefs of pain as mysterious (r = -.19, p = .02). The LMS was also positively correlated with attitudes towards the doctor's role in the treatment process (r = .20, p = .02).

Perceived control over pain. Regarding pain-specific control beliefs, we had predicted that those in the High Mindfulness Pain condition would demonstrate increased control over their pain after six days. Instead, we found that none of the groups saw increased personal control over their pain (as measured by the "Internal" subscale on the MHLC-Form C) after the intervention. We did, however, observe changes in two other health "locus of control" variables: Doctor and Fate/Chance.

Instead of movement on the "Internal" subscale, we found that those in the High Mindfulness Pain and Low Mindfulness Pain groups became more likely to attribute pain outcomes to their doctors. Those in Low and High Mindfulness Groups both became significantly more likely to endorse beliefs about the importance of the doctor-patient relationship. This "Doctor" subscale of the MHLC-Form C is composed of the following items: a)" If I see my doctor regularly, I am less likely to have problems with my condition" b) "Whenever my condition worsens, I should consult a trained professional" and c) "Following doctor's orders to the letter is the best way to keep my condition from getting any worse." These

items do not place all responsibility in the hands of a doctor, but also place the onus on the individual to communicate needs with a doctor and follow through with their recommendations. Future work could investigate how chronic pain patients communicate with their care team about their pain after an ATV intervention. For example, would they be more likely to follow a doctor's care instructions? Given the difficulty reported in getting patients to follow care plans as prescribed (e.g., DiMatteo, 1994), this would be an important question to follow up on. One hypothesis is that an ATV would be especially useful in improving a doctor-patient relationship because the patients have been able to notice patterns in the pain experience and work together with the doctor to capitalize on that knowledge. For example, if a person recognizes that pain is more severe in the morning, the doctor may help the patient identify factors that contribute to the pain.

In addition to increasingly endorsing the importance of doctors, the Low Mindfulness Pain group also became marginally more likely to endorse chance/fate (e.g., "Luck plays a big part in determining how my condition improves"), indicating an attitude shift away from internal locus of control. In fact, the only group that evidenced more personal control over the pain experience was the General Mindfulness group, who demonstrated more Self-blame about the pain than they did at baseline. At the same time, the General Mindfulness group was also the only one to show increased maladaptive cognitive patterns (i.e., magnification of pain). In the case of the pain experience, it may be the case that less focus of the self as agentic may ultimately lead to better results.

Attitudes towards pain. As expected, the "High Mindfulness Pain" group was significantly less likely to endorse pain as permanent at the outset. This was also the case for the General Mindfulness group, but in this group the change was also accompanied by maladaptive

changes including increased self-blame and pain magnification. Perhaps participants in the High Mindfulness group were more hopeful that they could capitalize on the fact that pain is not as permanent as they thought (i.e., through the doctor-patient relationship), while those in the General Mindfulness group were blaming the self for not tapping into the fact that pain is in flux. The current study does not allow us to understand why the "Pain as Permanent" might travel with certain outcomes, so this will be the task of future investigations.

We were surprised that there was no change in any of the groups on the measure of "Pain as Constant" on the PBAPI. This scale includes measures like: "I am continuously in pain" and "It seems like I wake up with pain and I go to sleep with pain." We expected that those in the High Mindfulness Group would demonstrate significantly decreased scores on this measure after our ATV intervention. Similarly, we were surprised that participants in the High Mindfulness group did not decrease on endorsements of "Pain as Mysterious." A future investigation could help us determine why we saw movement on the Pain as Permanent, but not on the of these other two subscales.

Pain Severity. While the three groups varied in their coping, pain catastrophizing, and pain beliefs, they also increased significantly in the amount of pain "on average" that they experienced. This finding perhaps makes positive changes in the High Mindfulness Pain group and General Mindfulness group more interesting, considering that they are accompanied by increased changes. Future investigations should investigate the factors that led to increased pain severity in all three groups.

Future directions

As was the case in the memory study in Chapter 2, we also do not know if the intervention would have been more or less effective in a different "dosage." One next step would

be to systematically vary the amount of time the intervention is delivered (both throughout the day and overall). One pervasive qualitative comment (entered into a text box in the follow-up session) was that the exercises seemed repetitive, especially the daily morning message that reminded people in the High Pain Mindfulness group to notice the fluctuations in their pain throughout the day. A future intervention could vary the morning text a bit from day to day so that it was not perceived as too monotonous.

Another future direction would be to hone in on the factors that are important to creating the impression that symptoms vary throughout the day. Our study included three components for the "High Mindfulness" group that differentiated it from the "Low Mindfulness" group: a randomized schedule, prompts for comparison, and morning reminders to pay attention to the variability and consider the underlying patterns. For example, is it important that we explicitly prompt participants to compare pain levels to the last time we asked them? This next step may be especially important given that we did not see movement on the "Pain as Constant" belief.

While we remind participants each morning to pay attention to the fluctuation and find patterns in how the pain was changing, we only supported the first instruction with our text message prompts. Future investigations could systematically investigate whether adding prompts asking participants to reflect on why the pain is changing would amplify the effects we saw in this study.

One potential limitation of the study was the heterogeneity of chronic pain conditions that our participants reported. Since there were so many different diagnoses reported, we could not statistically control for the diagnosis. As a result, we were unable to tell if some diagnoses were more amenable than others to our intervention. For example, it would make sense that if someone is given a diagnosis that is poorly understood then they may benefit from an

intervention that increases personal control over that disease. For example, chronic lower back pain is often the result of sitting for extended periods of time, while the etiology of Fibromyalgia is largely unknown (Wolfe et al., 1990).

Another limitation of this study was that our population was limited to those who were Caucasian women who were comfortable with technology (as most were recruited via social media websites) and owned a smartphone. In the future, it would be important to test our hypotheses with a broader demographic, as has been advocated in the field of psychology (e.g., (Arnett, 2015)

The research study described in this chapter is the first investigation of an ATV intervention with a clinical population. In this study, we found support for the hypothesis that our attention to variability intervention positively affects chronic pain patients, most notably decreased pain interference.

With the opioid crisis in the United States, it is more important than ever to identify treatment plans that supplement prescription medications, as roughly 21-29% of chronic pain patients who are prescribed opioids abuse them (Vowles et al., 2015). In the future, researchers should investigate how a refined ATV paradigm could be incorporated into a larger pain management strategy. Aside from applications of the ATV intervention, researchers can use the paradigm to better understand how attentional mechanisms affect the experience of pain. Specifically, we will continue to seek answers to the question, can attending to pain symptoms actually help patients and under what circumstances?

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Appendix A: Supplementary Analyses for Memory Study

Full Description of Differences in Demographic Variables, LMS, and GDS-sf

A one-way ANOVA revealed no significant difference in the age of our participants among the three conditions ($F(2, 153) = .11$, $p = .90$). Similarly, a one-way ANOVA revealed no statistically significant difference among the three conditions in the education level of our participants ($F(2, 153) = .59$, $p = .55$).

We also tested to see if the groups differed significantly at baseline on the following measures: the Geriatric Depression Scale (short form) and Langer Mindfulness Scale. For the descriptive statistics of GDS and LMS scores across the conditions see the figures below.

A one-way ANOVA revealed no significant difference in mean Geriatric Depression Scale scores among the three conditions ($F(2, 153) = .06$, $p = .94$). Similarly, a one-way ANOVA revealed no statistically significant difference among the three conditions in baseline Langer Mindfulness Scale scores ($F(2, 153) = 1.81$, $p = .17$).

Figure 3.0. Homogeneity of Regression Slopes for "Present Ability"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory _Present Ability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1315.408[a]	5	263.082	46.178	.000
Intercept	101.010	1	101.010	17.730	.000
Condition	1.117	2	.558	.098	.907
MCI_PresentAbility_S1	1166.010	1	1166.010	204.667	.000
Condition * MCI_PresentAbility_S1	.131	2	.065	.011	.989
Error	854.567	150	5.697		
Total	35786.000	156			
Corrected Total	2169.974	155			

a. R Squared = .606 (Adjusted R Squared = .593)

Figure 3.1. Homogeneity of Regression Slopes for "Potential Improvement"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory - Potential Improvement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	631.787[a]	5	126.357	35.867	.000
Intercept	82.095	1	82.095	23.303	.000
Condition	22.834	2	11.417	3.241	.042
MCI_PotentialImprovement_S1	613.581	1	613.581	174.167	.000
Condition * MCI_PotentialImprovement_S1	18.565	2	9.283	2.635	.075
Error	528.443	150	3.523		
Total	40142.000	156			
Corrected Total	1160.231	155			

a. R Squared = .545 (Adjusted R Squared = .529)

Figure 3.2. Homogeneity of Regression Slopes for "Effort Utility"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory - Effort Utility

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	618.113[a]	5	123.623	30.463	.000
Intercept	89.732	1	89.732	22.111	.000
Condition	15.974	2	7.987	1.968	.143
MCI_EffortUtility_S1	591.396	1	591.396	145.729	.000
Condition * MCI_EffortUtility_S1	11.580	2	5.790	1.427	.243
Error	608.727	150	4.058		
Total	36477.000	156			
Corrected Total	1226.840	155			

a. R Squared = .504 (Adjusted R Squared = .487)

Figure 3.3. Homogeneity of Regression Slopes for "Inevitable Decrement"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory- Inevitable Decrement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1172.533[a]	5	234.507	38.992	.000
Intercept	135.224	1	135.224	22.484	.000
Condition	27.162	2	13.581	2.258	.108
MCI_InevitableDecrement_S1	1080.160	1	1080.160	179.601	.000
Condition * MCI_InevitableDecrement_S1	11.342	2	5.671	.943	.392
Error	902.134	150	6.014		
Total	18732.000	156			
Corrected Total	2074.667	155			

a. R Squared = .565 (Adjusted R Squared = .551)

Figure 3.4. Homogeneity of Regression Slopes for "Independence"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory - Independence

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	848.027[a]	5	169.605	28.324	.000
Intercept	110.192	1	110.192	18.402	.000
Condition	20.903	2	10.452	1.745	.178
MCI_Independence_S1	843.475	1	843.475	140.861	.000
Condition * MCI_Independence_S1	18.220	2	9.110	1.521	.222
Error	898.197	150	5.988		
Total	27055.000	156			
Corrected Total	1746.224	155			

a. R Squared = .486 (Adjusted R Squared = .468)

Figure 3.5. Homogeneity of Regression Slopes for "Alzheimer's Likelihood"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory - Alzheimer's Likelihood

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2796.271[a]	5	559.254	46.733	.000
Intercept	38.604	1	38.604	3.226	.074
Condition	35.247	2	17.624	1.473	.233
MCI_AlzLikelihood_S1	2697.754	1	2697.754	225.434	.000
Condition * MCI_AlzLikelihood_S1	11.080	2	5.540	.463	.630
Error	1795.036	150	11.967		
Total	36698.000	156			
Corrected Total	4591.308	155			

a. R Squared = .609 (Adjusted R Squared = .596)

Figure 3.6. Homogeneity of Regression Slopes for Reported Number of Memory Lapses

Tests of Between-Subjects Effects

Dependent Variable: EverydayMemory_Total_S2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	123.155[a]	5	24.631	4.500	.001
Intercept	148.111	1	148.111	27.058	.000
Condition	14.117	2	7.059	1.290	.278
EverydayMemory_Total_S1	87.637	1	87.637	16.010	.000
Condition * EverydayMemory_Total_S1	9.342	2	4.671	.853	.428
Error	821.069	150	5.474		
Total	3529.000	156			
Corrected Total	944.224	155			

a. R Squared = .130 (Adjusted R Squared = .101)

Figure 3.7. Homogeneity of Regression Slopes for Reported Stress Over Memory Lapses

Tests of Between-Subjects Effects

Dependent Variable: EverydayMemory_Stress_S2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	52.386[a]	5	10.477	2.389	.041
Intercept	229.949	1	229.949	52.426	.000
Condition	.010	2	.005	.001	.999
EverydayMemory_Stress_S1	40.476	1	40.476	9.228	.003
Condition * EverydayMemory_Stress_S1	2.026	2	1.013	.231	.794
Error	657.922	150	4.386		
Total	3018.000	156			
Corrected Total	710.308	155			

a. R Squared = .074 (Adjusted R Squared = .043)

Figure 3.8. Test of Homogeneity of Error Variances for "Present Ability"

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Memory Controllability Inventory _Present Ability

F	df1	df2	Sig.
1.279	2	153	.281

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MCI_PresentAbility_S1 + Condition

Figure 3.9. Test of Homogeneity of Error Variances for "Potential Improvement"

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Memory Controllability Inventory - Potential Improvement

F	df1	df2	Sig.
.150	2	153	.861

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MCI_PotentialImprovement_S1 + Condition

Figure 3.10. Test of Homogeneity of Error Variances for "Effort Utility"

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Memory Controllability Inventory - Effort Utility

F	df1	df2	Sig.
.425	2	153	.655

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MCI_EffortUtility_S1 + Condition

Figure 3.11. Test of Homogeneity of Error Variances for "Inevitable Decrement"

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Memory Controllability Inventory- Inevitable Decrement

F	df1	df2	Sig.
1.469	2	153	.233

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MCI_InevitableDecrement_S1 + Condition

Figure 3.12. Test of Homogeneity of Error Variances for "Independence"

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Memory Controllability Inventory - Independence

F	df1	df2	Sig.
1.469	2	153	.233

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MCI_Independence_S1 + Condition

Figure 3.13. Test of Homogeneity of Error Variances for "Alzheimer's Likelihood"

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Memory Controllability Inventory - Alzheimer's Likelihood

F	df1	df2	Sig.
1.610	2	153	.203

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MCI_AlzLikelihood_S1 + Condition

Figure 3.14. Test of Homogeneity of Error Variances for Reported Number of Memory Lapses

Levene's Test of Equality of Error Variances[a]

Dependent Variable: EverydayMemory_Total_S2

F	df1	df2	Sig.
1.511	2	153	.224

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + EverydayMemory_Total_S1 + Condition

Figure 3.15. Test of Homogeneity of Error Variances for Reported Stress About Memory Lapses

Levene's Test of Equality of Error Variances[a]

Dependent Variable: EverydayMemory_Stress_S2

F	df1	df2	Sig.
5.242	2	153	.006

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + EverydayMemory_Stress_S1 + Condition

Figure 3.16. Test of Homogeneity of Error Variances for Reported Stress About Memory Lapses After Reciprocal Transformation

Levene's Test of Equality of Error Variances[a]

Dependent Variable: EverdayMemory_Stress_Reciprocal

F	df1	df2	Sig.
1.132	2	148	.325

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Condition

Figure 3.17. Boxplot of MCI- "Present Ability" at T1

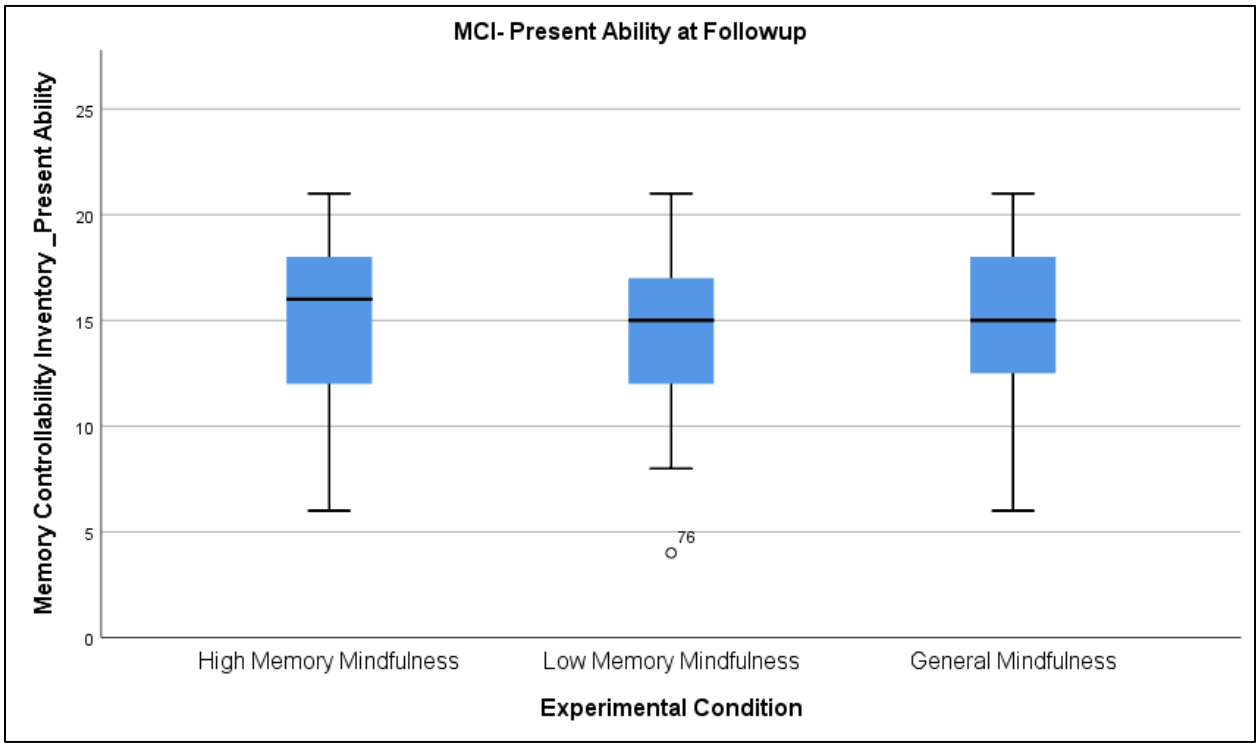


Figure 3.18. Boxplot of MCI- "Potential Improvement" at T1

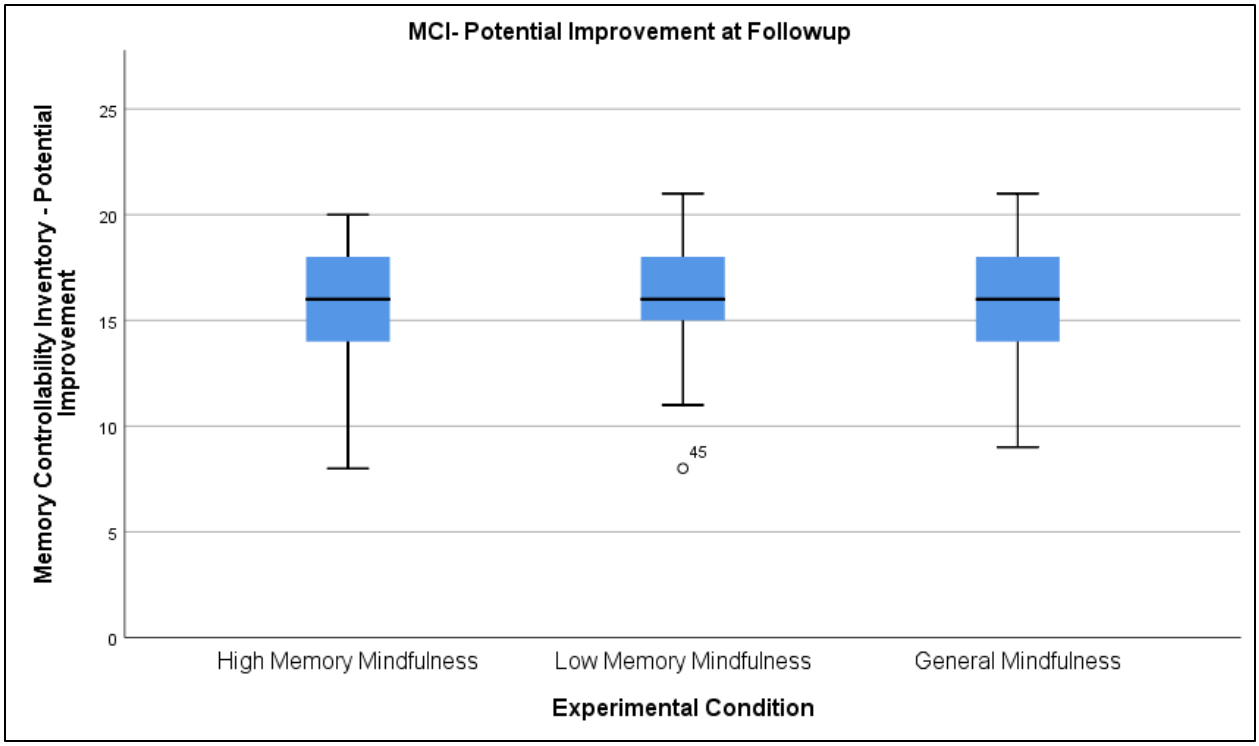


Figure 3.19. Boxplot of MCI- "Effort Utility" at T1

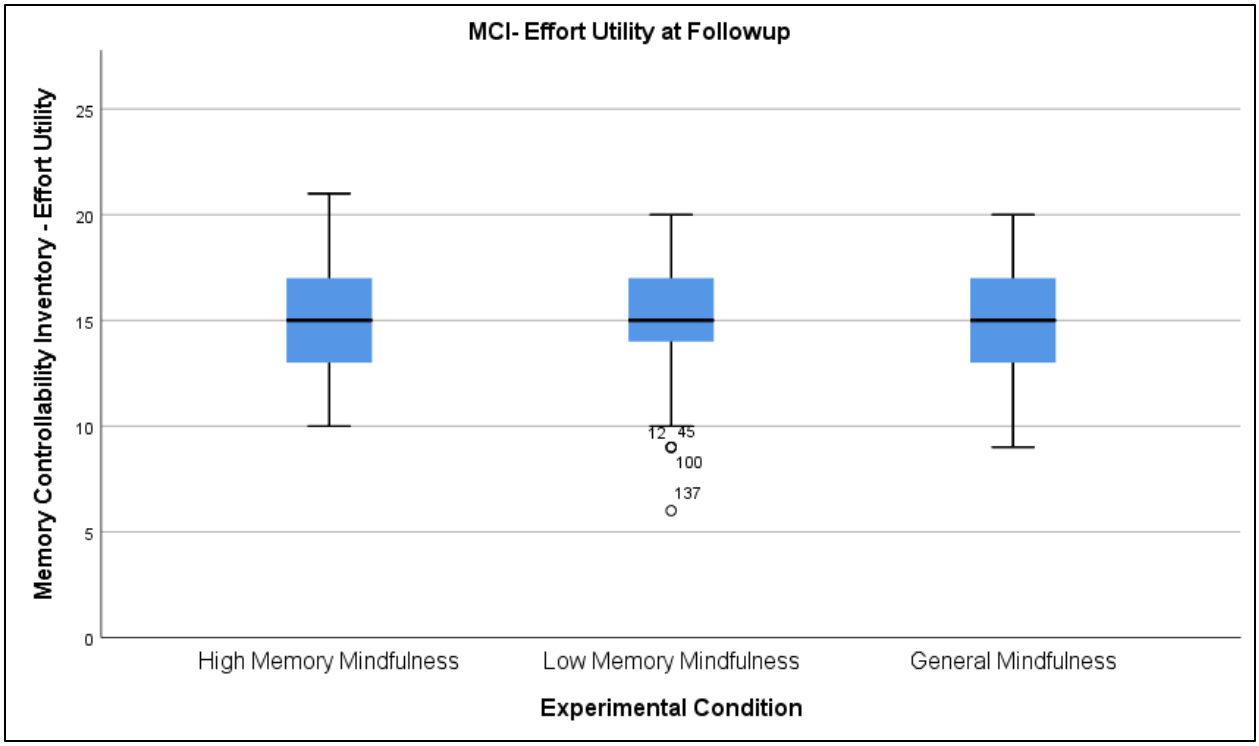


Figure 3.20. Boxplot of MCI- "Inevitable Decrement" at T1

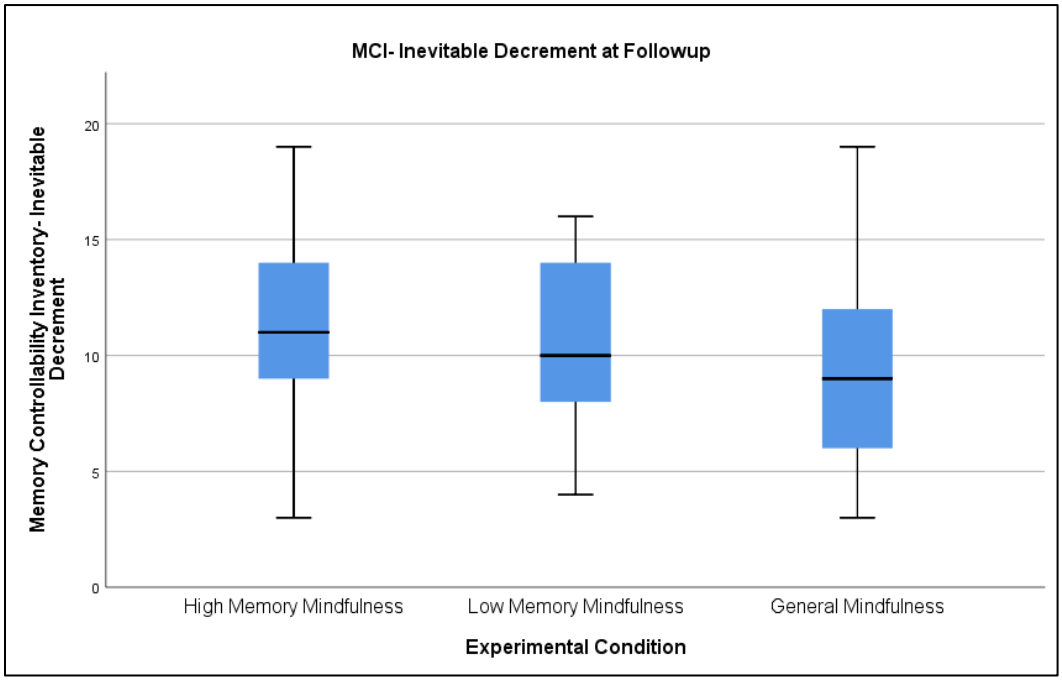


Figure 3.21. Boxplot of MCI- "Independence" at T1

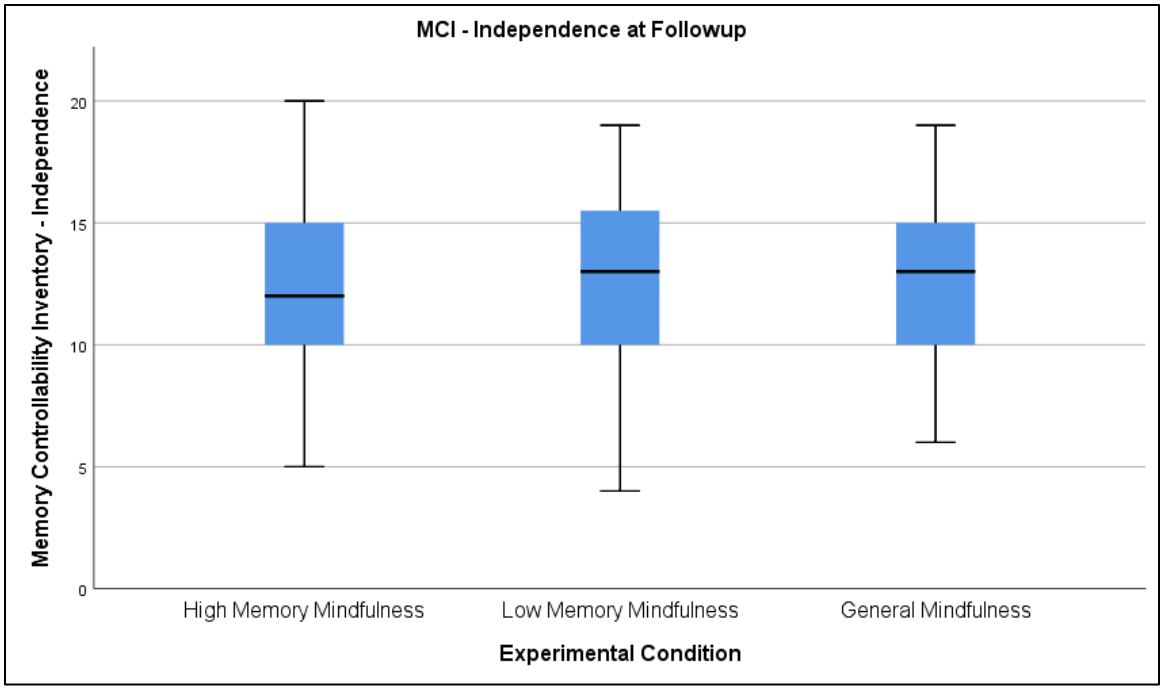


Figure 3.22. Boxplot of MCI- "Alzheimer's Likelihood" at T1

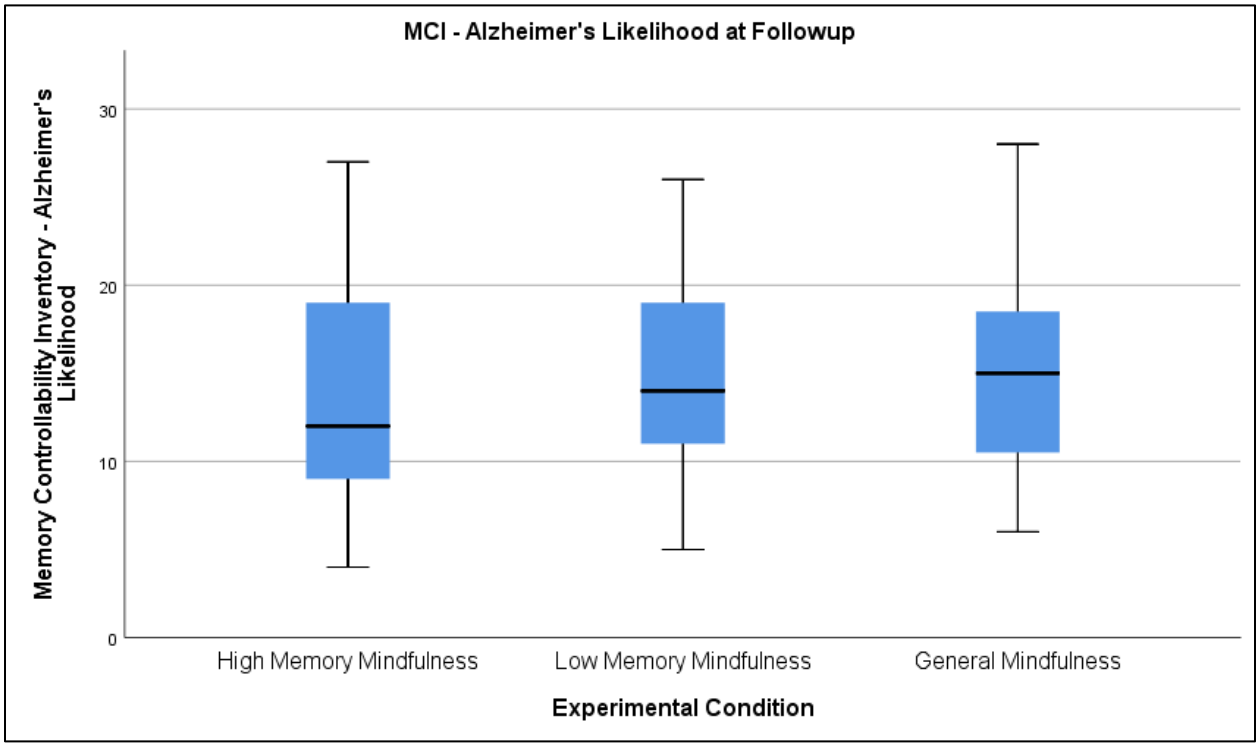


Figure 3.23. Boxplot of EMQ- Number of Reported Memory Lapses at T1

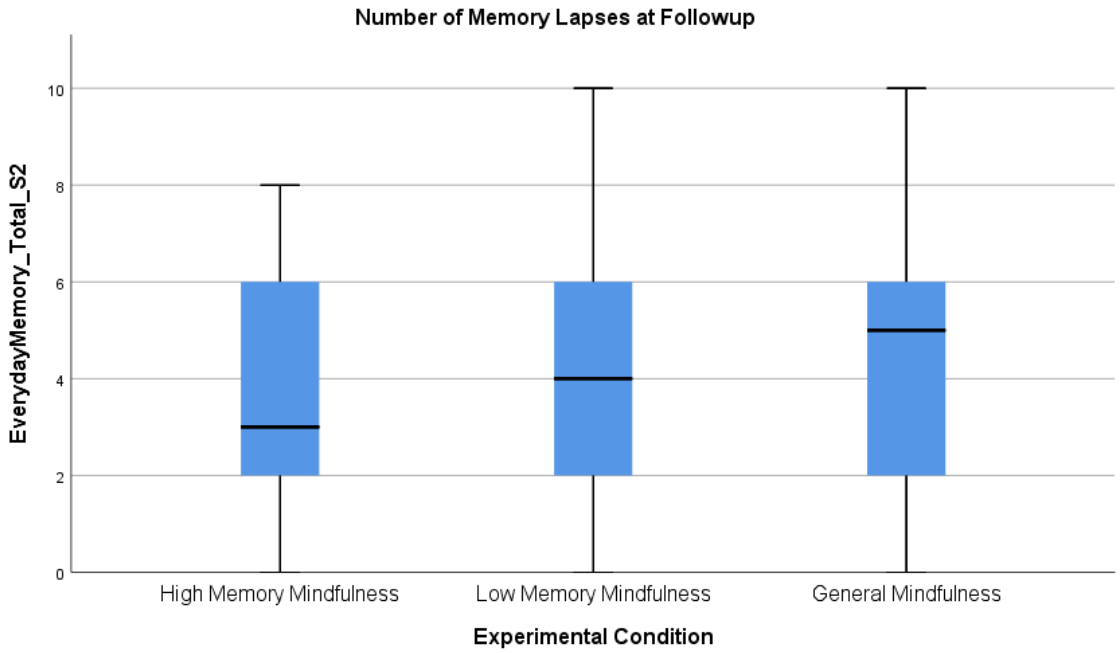


Figure 3.24. Boxplot of EMQ- Stress About Memory Lapses at T1

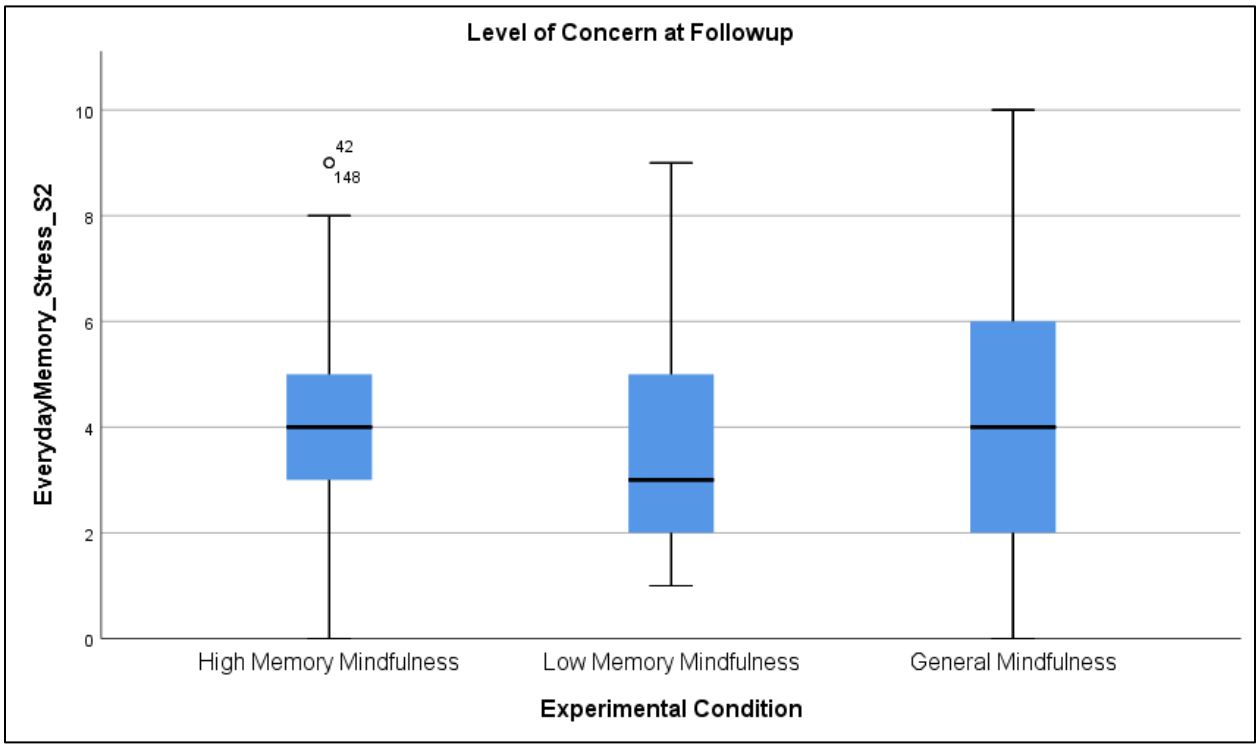


Figure 3.25. Table of inter-correlations among the variables of the BTACT

Correlations

nber		TWO_WLR_Unique	TWO_Digit_Span	TWO_CF_Unique	TWO_RGA_Normal	TWO_RGA_Reverse	TWO_RGAExperimental	TWO_WLR_D_Unique
TWO_WLR_Unique	Pearson Correlation	1	.316**	.143	.156	.036	.084	.697**
	Sig. (2-tailed)		.000	.081	.057	.662	.307	.000
	N	150	149	149	149	149	149	149
TWO_Digit_Span	Pearson Correlation	.316**	1	.192*	-.007	.007	-.096	.199*
	Sig. (2-tailed)	.000		.019	.936	.937	.248	.015
	N	149	149	148	148	148	148	148
TWO_CF_Unique	Pearson Correlation	.143	.192*	1	-.087	-.022	-.063	.257**
	Sig. (2-tailed)	.081	.019		.291	.790	.445	.002
	N	149	148	149	148	148	148	148
TWO_RGA_Normal	Pearson Correlation	.156	-.007	-.087	1	.294**	.047	.129
	Sig. (2-tailed)	.057	.936	.291		.000	.567	.116
	N	149	148	148	150	150	150	149
TWO_RGA_Reverse	Pearson Correlation	.036	.007	-.022	.294**	1	.152	.164*
	Sig. (2-tailed)	.662	.937	.790	.000		.063	.046
	N	149	148	148	150	150	150	149
TWO_RGAExperimental	Pearson Correlation	.084	-.096	-.063	.047	.152	1	.038
	Sig. (2-tailed)	.307	.248	.445	.567	.063		.642
	N	149	148	148	150	150	150	149
TWO_WLR_D_Unique	Pearson Correlation	.697**	.199*	.257**	.129	.164*	.038	1
	Sig. (2-tailed)	.000	.015	.002	.116	.046	.642	
	N	149	148	148	149	149	149	149

Figure 3.26. Test of Homogeneity of Variance for the BTACT subtests

Levene's Test of Equality of Error Variances[a]

Imputation Number			Levene Statistic	df1	df2	Sig.
Original data	TWO_WLR_Unique	Based on Mean	.369	2	144	.692
		Based on Median	.295	2	144	.745
		Based on Median and with adjusted df	.295	2	142.463	.745
		Based on trimmed mean	.388	2	144	.679
	TWO_Digit_Span	Based on Mean	2.313	2	144	.103
		Based on Median	2.110	2	144	.125
		Based on Median and with adjusted df	2.110	2	137.952	.125
		Based on trimmed mean	2.375	2	144	.097
	TWO_CF_Unique	Based on Mean	1.624	2	144	.201
		Based on Median	.923	2	144	.400
		Based on Median and with adjusted df	.923	2	142.691	.400
		Based on trimmed mean	1.530	2	144	.220
	TWO_RGA_Normal	Based on Mean	2.253	2	144	.109
		Based on Median	.527	2	144	.592
		Based on Median and with adjusted df	.527	2	124.001	.592
		Based on trimmed mean	1.610	2	144	.203
	TWO_RGA_Reverse	Based on Mean	3.899	2	144	.022
		Based on Median	1.220	2	144	.298
		Based on Median and with adjusted df	1.220	2	135.680	.299
		Based on trimmed mean	3.418	2	144	.035
	TWO_RGAExperimental	Based on Mean	1.434	2	144	.242
		Based on Median	.654	2	144	.522
		Based on Median and with adjusted df	.654	2	113.427	.522
		Based on trimmed	.924	2	144	.399
	TWO_WLR_D_Unique	Based on Mean	.903	2	144	.408
		Based on Median	.751	2	144	.474
		Based on Median and with adjusted df	.751	2	140.267	.474
		Based on trimmed mean	.925	2	144	.399

Figure 3.27. Descriptive Statistics of Participant Age across Experimental Conditions

Descriptives

Age

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
High Memory Mindfulness	49	69.47	3.808	.544	68.38	70.56	62	80
Low Memory Mindfulness	52	68.72	9.787	1.357	66.00	71.45	4	80
General Mindfulness	55	68.93	9.371	1.264	66.39	71.46	7	80
Total	156	69.03	8.167	.654	67.74	70.32	4	80

Figure 3.28. Descriptive Statistics of Participant Education across Experimental Conditions

Descriptives

How many years of formal schooling did you have? (12= finished high school, 16=finished undergraduate)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
High Memory Mindfulness	49	16.70	3.753	.536	15.62	17.78	-1	24
Low Memory Mindfulness	52	16.74	4.507	.625	15.48	17.99	-2	25
General Mindfulness	55	17.38	2.384	.321	16.74	18.03	12	23
Total	156	16.95	3.623	.290	16.38	17.53	-2	25

Figure 3.28. One-way ANOVA Comparing Age Across Experimental Condition

ANOVA

Age

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15.016	2	7.508	.111	.895
Within Groups	10323.436	153	67.473		
Total	10338.452	155			

Figure 3.29. One-way ANOVA Comparing Education Across Experimental Condition

ANOVA

How many years of formal schooling did you have? (12= finished high school, 16=finished undergraduate)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15.662	2	7.831	.593	.554
Within Groups	2019.159	153	13.197		
Total	2034.820	155			

Figure 3.30. Descriptive Statistics of Geriatric Depression Scale Scores across Experimental Conditions

Descriptives

Geriatric Depression Scale

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
High Memory Mindfulness	49	5.84	1.724	.246	5.34	6.33	2	10
Low Memory Mindfulness	52	5.73	1.359	.188	5.35	6.11	3	9
General Mindfulness	55	5.80	1.556	.210	5.38	6.22	2	10
Total	156	5.79	1.541	.123	5.54	6.03	2	10

Figure 3.31. Descriptive Statistics of Langer Mindfulness Scale Scores across Experimental Conditions

Descriptives

Langer Mindfulness Scale - Total - Session 1

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
High Memory Mindfulness	49	77.69	9.986	1.427	74.83	80.56	47	97
Low Memory Mindfulness	52	78.15	8.987	1.246	75.65	80.66	57	97
General Mindfulness	55	74.76	10.963	1.478	71.80	77.73	43	95
Total	156	76.81	10.083	.807	75.22	78.41	43	97

Figure 3.32. One-way ANOVA Comparing Geriatric Depression Scale Scores Across Experimental Conditions

ANOVA

Geriatric Depression Scale

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.295	2	.147	.061	.941
Within Groups	367.725	153	2.403		
Total	368.019	155			

Figure 3.33. One-way ANOVA Comparing Langer Mindfulness Scale Scores Across Experimental Conditions

ANOVA

Langer Mindfulness Scale - Total - Session 1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	362.504	2	181.252	1.801	.169
Within Groups	15395.105	153	100.622		
Total	15757.609	155			

Figure 3.34. Test of Equality of Means for "Present Ability" at T0

Robust Tests of Equality of Means

Memory Controllability Inventory- Present Ability

	Statistic[a]	df1	df2	Sig.
Welch	.379	2	100.496	.686
Brown-Forsythe	.348	2	143.074	.707

a. Asymptotically F distributed.

Figure 3.35. ANCOVA Results for "Present Ability"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory _Present Ability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1315.277[a]	3	438.426	77.970	.000	.606
Intercept	112.142	1	112.142	19.943	.000	.116
MCI_PresentAbility_S1	1310.703	1	1310.703	233.096	.000	.605
Condition	15.881	2	7.941	1.412	.247	.018
Error	854.697	152	5.623			
Total	35786.000	156				
Corrected Total	2169.974	155				

a. R Squared = .606 (Adjusted R Squared = .598)

Figure 3.36. Estimated Marginal Means for "Present Ability" at T1

Estimates

Dependent Variable: Memory Controllability Inventory _Present Ability

Experimental Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Memory Mindfulness	14.982[a]	.339	14.313	15.651
Low Memory Mindfulness	14.236[a]	.329	13.586	14.887
General Mindfulness	14.829[a]	.320	14.197	15.461

a. Covariates appearing in the model are evaluated at the following values: Memory Controllability Inventory- Present Ability = 14.24.

Figure 3.37. Test of Equality of Means for "Potential Improvement" at T0

Robust Tests of Equality of Means

Memory Controllability Inventory - Potential Improvement

	Statistic[a]	df1	df2	Sig.
Welch	2.127	2	96.822	.125
Brown-Forsythe	2.182	2	133.528	.117

a. Asymptotically F distributed.

Figure 3.38. ANCOVA Results for "Potential Improvement"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory - Potential Improvement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	613.222[a]	3	204.407	56.800	.000	.529
Intercept	112.890	1	112.890	31.369	.000	.171
MCI_PotentialImprovement_S1	608.609	1	608.609	169.117	.000	.527
Condition	11.729	2	5.865	1.630	.199	.021
Error	547.009	152	3.599			
Total	40142.000	156				
Corrected Total	1160.231	155				

a. R Squared = .529 (Adjusted R Squared = .519)

Figure 3.39. Estimated Marginal Means for "Potential Improvement" at T1

Estimates

Dependent Variable: Memory Controllability Inventory - Potential Improvement

Experimental Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Memory Mindfulness	16.050[a]	.273	15.510	16.590
Low Memory Mindfulness	15.974[a]	.263	15.454	16.494
General Mindfulness	15.434[a]	.257	14.926	15.943

a. Covariates appearing in the model are evaluated at the following values: Memory Controllability Inventory - Potential Improvement = 15.61.

Figure 3.40. Test of Equality of Means for "Effort Utility" at T0

ANOVA

Memory Controllability Inventory- Effort Utility

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.723	2	6.362	.789	.456
Within Groups	1233.296	153	8.061		
Total	1246.019	155			

Figure 3.41. ANCOVA Results for "Effort Utility"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory - Effort Utility

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	606.533[a]	3	202.178	49.542	.000	.494
Intercept	96.046	1	96.046	23.535	.000	.134
MCI_EffortUtility_S1	602.601	1	602.601	147.661	.000	.493
Condition	12.192	2	6.096	1.494	.228	.019
Error	620.307	152	4.081			
Total	36477.000	156				
Corrected Total	1226.840	155				

a. R Squared = .494 (Adjusted R Squared = .484)

Figure 3.42. Estimated Marginal Means for "Effort Utility" at T1

Estimates

Dependent Variable: Memory Controllability Inventory - Effort Utility

Experimental Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Memory Mindfulness	15.002[a]	.289	14.431	15.572
Low Memory Mindfulness	14.698[a]	.281	14.143	15.254
General Mindfulness	15.374[a]	.273	14.836	15.913

a. Covariates appearing in the model are evaluated at the following values: Memory Controllability Inventory- Effort Utility = 15.29.

Figure 3.43. Test of Equality of Means for "Independence" at T0

ANOVA

Memory Controllability Inventory- Independence

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14.023	2	7.012	.606	.547
Within Groups	1768.951	153	11.562		
Total	1782.974	155			

Figure 3.44. ANCOVA Results for "Independence"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory - Independence

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	829.808[a]	3	276.603	45.878	.000	.475
Intercept	132.409	1	132.409	21.962	.000	.126
MCI_Independence_S1	828.729	1	828.729	137.456	.000	.475
Condition	4.086	2	2.043	.339	.713	.004
Error	916.417	152	6.029			
Total	27055.000	156				
Corrected Total	1746.224	155				

a. R Squared = .475 (Adjusted R Squared = .465)

Figure 3.45. Estimated Marginal Means for "Independence" at T1

Estimates

Dependent Variable: Memory Controllability Inventory - Independence

Experimental Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Memory Mindfulness	12.923[a]	.352	12.228	13.618
Low Memory Mindfulness	12.525[a]	.341	11.851	13.198
General Mindfulness	12.773[a]	.331	12.118	13.427

a. Covariates appearing in the model are evaluated at the following values: Memory Controllability Inventory- Independence = 13.18.

Figure 3.46. Test of Equality of Means for "Inevitable Decrement" at T0

ANOVA

Memory Controllability Inventory- Inevitable Decrement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19.701	2	9.851	.753	.473
Within Groups	2002.472	153	13.088		
Total	2022.173	155			

Figure 3.47. ANCOVA Results for "Inevitable Decrement"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory- Inevitable Decrement

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1161.191[a]	3	387.064	64.406	.000	.560
Intercept	139.457	1	139.457	23.205	.000	.132
MCI_InevitableDecrement_S1	1100.136	1	1100.136	183.060	.000	.546
Condition	39.607	2	19.804	3.295	.040	.042
Error	913.476	152	6.010			
Total	18732.000	156				
Corrected Total	2074.667	155				

a. R Squared = .560 (Adjusted R Squared = .551)

Figure 3.48. Estimated Marginal Means for "Inevitable Decrement" at T1

Estimates

Dependent Variable: Memory Controllability Inventory- Inevitable Decrement

Experimental Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Memory Mindfulness	10.636[a]	.351	9.942	11.330
Low Memory Mindfulness	10.767[a]	.340	10.094	11.439
General Mindfulness	9.654[a]	.331	9.001	10.307

a. Covariates appearing in the model are evaluated at the following values: Memory Controllability Inventory- Inevitable Decrement = 10.13.

Figure 3.49. Pairwise comparisons for Estimated Marginal Means of "Inevitable Decrement"

Pairwise Comparisons

Dependent Variable: Memory Controllability Inventory- Inevitable Decrement

(I) Experimental Condition	(J) Experimental Condition	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
High Memory Mindfulness	Low Memory Mindfulness	-.130	.490	1.000	-1.317	1.056
	General Mindfulness	.982	.483	.131	-.187	2.151
Low Memory Mindfulness	High Memory Mindfulness	.130	.490	1.000	-1.056	1.317
	General Mindfulness	1.113	.474	.061	-.035	2.261
General Mindfulness	High Memory Mindfulness	-.982	.483	.131	-2.151	.187
	Low Memory Mindfulness	-1.113	.474	.061	-2.261	.035

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

Figure 3.50. Test of Equality of Means for "Alzheimer's Likelihood" at T0

ANOVA

Memory Controllability Inventory - Alzheimer's Likelihood

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	66.503	2	33.251	1.466	.234
Within Groups	3469.722	153	22.678		
Total	3536.224	155			

Figure 3.51. ANCOVA Results for "Alzheimer's Likelihood"

Tests of Between-Subjects Effects

Dependent Variable: Memory Controllability Inventory - Alzheimer's Likelihood

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2785.192[a]	3	928.397	78.133	.000	.607
Intercept	38.863	1	38.863	3.271	.073	.021
MCI_AlzLikelihood_S1	2701.714	1	2701.714	227.372	.000	.599
Condition	80.199	2	40.100	3.375	.037	.043
Error	1806.116	152	11.882			
Total	36698.000	156				
Corrected Total	4591.308	155				

a. R Squared = .607 (Adjusted R Squared = .599)

Figure 3.52. Estimated Marginal Means for "Alzheimer's Likelihood" at T1

Estimates

Dependent Variable: Memory Controllability Inventory - Alzheimer's Likelihood

Experimental Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Memory Mindfulness	13.608[a]	.493	12.634	14.582
Low Memory Mindfulness	15.325[a]	.479	14.378	16.271
General Mindfulness	14.078[a]	.468	13.154	15.002

a. Covariates appearing in the model are evaluated at the following values: Memory Controllability Inventory - Alzheimer's Likelihood = 14.43.

Figure 3.53. Pairwise comparisons for Estimated Marginal Means of "Alzheimer's Likelihood"

Pairwise Comparisons

Dependent Variable: Memory Controllability Inventory - Alzheimer's Likelihood

(I) Experimental Condition	(J) Experimental Condition	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
High Memory Mindfulness	Low Memory Mindfulness	-1.716*	.686	.040	-3.378	-.055
	General Mindfulness	-.470	.681	1.000	-2.119	1.179
Low Memory Mindfulness	High Memory Mindfulness	1.716*	.686	.040	.055	3.378
	General Mindfulness	1.246	.672	.197	-.381	2.873
General Mindfulness	High Memory Mindfulness	.470	.681	1.000	-1.179	2.119
	Low Memory Mindfulness	-1.246	.672	.197	-2.873	.381

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Figure 3.54. Test of Equality of Means for "Reported Memory Lapses" at T0

ANOVA

EverydayMemory_Total_S1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.630	2	5.815	1.082	.341
Within Groups	822.139	153	5.373		
Total	833.769	155			

Figure 3.55. ANCOVA Results for "Reported Memory Lapses"

Tests of Between-Subjects Effects

Dependent Variable: EverydayMemory_Total_S2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	113.813[a]	3	37.938	6.944	.000	.121
Intercept	141.453	1	141.453	25.892	.000	.146
EverydayMemory_Total_S1	107.578	1	107.578	19.691	.000	.115
Condition	9.846	2	4.923	.901	.408	.012
Error	830.411	152	5.463			
Total	3529.000	156				
Corrected Total	944.224	155				

a. R Squared = .121 (Adjusted R Squared = .103)

Figure 3.56. Estimated Marginal Means for "Reported Memory Lapses"

Estimates

Dependent Variable: EverydayMemory_Total_S2

Experimental Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Memory Mindfulness	3.717[a]	.334	3.057	4.378
Low Memory Mindfulness	4.331[a]	.326	3.688	4.975
General Mindfulness	4.138[a]	.316	3.515	4.762

a. Covariates appearing in the model are evaluated at the following values: EverydayMemory_Total_S1 = 4.96.

Figure 3.57. Test of Equality of Means for Memory-related Stress at T0

ANOVA

EverydayMemory_Stress_S1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.136	2	1.068	.207	.813
Within Groups	790.300	153	5.165		
Total	792.436	155			

Figure 3.58. ANCOVA Results for Memory-related Stress Scores (Transformed)

Tests of Between-Subjects Effects

Dependent Variable: EverdayMemory_Stress_Reciprocal

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.452[a]	3	.151	2.849	.040	.055
Intercept	5.775	1	5.775	109.283	.000	.426
EverydayMemory_Stress_S1	.352	1	.352	6.664	.011	.043
Condition	.116	2	.058	1.099	.336	.015
Error	7.768	147	.053			
Total	26.480	151				
Corrected Total	8.220	150				

a. R Squared = .055 (Adjusted R Squared = .036)

Figure 3.59. Estimated Marginal Means for Memory-related Stress Scores (Transformed)

Estimates

Dependent Variable: EverdayMemory_Stress_Reciprocal

Experimental Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Memory Mindfulness	.323[a]	.033	.258	.389
Low Memory Mindfulness	.386[a]	.032	.323	.449
General Mindfulness	.332[a]	.032	.268	.396

a. Covariates appearing in the model are evaluated at the following values: EverydayMemory_Stress_S1 = 4.66.

Figure 3.60. MANOVA for BTACT scores

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	1.000	91430.388[b]	7.000	134.000	.000	1.000
	Wilks' Lambda	.000	91430.388[b]	7.000	134.000	.000	1.000
	Hotelling's Trace	4776.214	91430.388[b]	7.000	134.000	.000	1.000
	Roy's Largest Root	4776.214	91430.388[b]	7.000	134.000	.000	1.000
Condition	Pillai's Trace	.089	.899	14.000	270.000	.560	.045
	Wilks' Lambda	.913	.894[b]	14.000	268.000	.566	.045
	Hotelling's Trace	.094	.888	14.000	266.000	.572	.045
	Roy's Largest Root	.059	1.137[c]	7.000	135.000	.344	.056

Figure 3.61. Paired-sample t-tests for BTACT in High Mindfulness Memory Condition

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	TWO_WLR_Unique - WLR_Unique	.188	2.394	.346	-.508	.883	.543	47	.590
Pair 2	TWO_Digit_Span - Digit_Span	.063	1.174	.169	-.278	.403	.369	47	.714
Pair 3	TWO_CF_Unique - CF_Unique	2.064	7.711	1.125	-.200	4.328	1.835	46	.073
Pair 4	TWO_RGA_Normal - RGA_Normal	-.085	.408	.060	-.205	.035	-1.430	46	.160
Pair 5	TWO_RGA_Reverse - RGA_Reverse	.085	.654	.095	-.107	.277	.892	46	.377
Pair 6	TWO_RGAExperimental - RGA_Experimental	.213	3.007	.439	-.670	1.096	.485	46	.630
Pair 7	TWO_WLR_D_Unique - WLR_D_Unique	.255	2.498	.364	-.478	.989	.701	46	.487

Figure 3.61. Paired-sample t-tests for BTACT in Low Mindfulness Memory Condition

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	TWO_Digit_Span - Digit_Span	.163	1.280	.183	-.205	.531	.893	48	.377
Pair 2	TWO_CF_Unique - CF_Unique	1.061	9.532	1.362	-1.677	3.799	.779	48	.440
Pair 3	TWO_WLR_Unique - WLR_Unique	.510	2.042	.292	-.076	1.097	1.749	48	.087
Pair 4	TWO_RGA_Normal - RGA_Normal	.040	.402	.057	-.074	.154	.704	49	.485
Pair 5	TWO_RGA_Reverse - RGA_Reverse	-.040	.638	.090	-.221	.141	-.444	49	.659
Pair 6	TWO_RGAExperimental - RGA_Experimental	.020	1.421	.201	-.384	.424	.100	49	.921
Pair 7	TWO_WLR_D_Unique - WLR_D_Unique	.061	2.726	.389	-.722	.844	.157	48	.876

Figure 3.62. Paired-sample t-tests for BTACT in General Mindfulness Memory Condition

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	TWO_Digit_Span - Digit_Span	.231	1.231	.171	-.112	.573	1.352	51	.182
Pair 2	TWO_CF_Unique - CF_Unique	.865	7.675	1.064	-1.271	3.002	.813	51	.420
Pair 3	TWO_WLR_Unique - WLR_Unique	.151	2.152	.296	-.442	.744	.511	52	.612
Pair 4	TWO_RGA_Normal - RGA_Normal	.000	.480	.066	-.132	.132	.000	52	1.000
Pair 5	TWO_RGA_Reverse - RGA_Reverse	-.019	.720	.099	-.217	.180	-.191	52	.850
Pair 6	TWO_RGAExperimental - RGA_Experimental	.528	3.667	.504	-.482	1.539	1.049	52	.299
Pair 7	TWO_WLR_D_Unique - WLR_D_Unique	.170	1.939	.266	-.365	.704	.638	52	.527

Figure 3.63. Chi-square test for effect of LMS Quartile on Subjective Memory Score

LMS_25 * Lapses_Change_String Crosstabulation

Count

		Lapses_Change_String		
		Decreases	Increases	Total
LMS_25	Bottom 25%	19	9	28
	Top 25%	26	16	42
Total		45	25	70

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.259[a]	1	.611		
Continuity Correction[b]	.065	1	.799		
Likelihood Ratio	.261	1	.610		
Fisher's Exact Test				.799	.402
Linear-by-Linear Association	.256	1	.613		
N of Valid Cases	70				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.00.

b. Computed only for a 2x2 table

Figure 3.64. Chi-square test for effect of LMS Quartile on Stress about Memory

LMS_25 * Stress_Change_String Crosstabulation

Count

		Stress_Change_String		
		Decrease	Increase	Total
LMS_25	Bottom 25%	19	14	33
	Top 25%	22	15	37
Total		41	29	70

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.026[a]	1	.873		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.026	1	.873		
Fisher's Exact Test				1.000	.533
Linear-by-Linear Association	.025	1	.874		
N of Valid Cases	70				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.67.

b. Computed only for a 2x2 table

Figure 3.65. Chi-square test for Effect of LMS Quartile on MCI- Present Ability

LMS_25 * Present_Ability_Change_String Crosstabulation

Count

		Present_Ability_Change_String		
		Decreased	Increased	Total
LMS_25	Bottom 25%	12	17	29
	Top 25%	15	22	37
Total		27	39	66

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.005[a]	1	.945		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.005	1	.945		
Fisher's Exact Test				1.000	.572
Linear-by-Linear Association	.005	1	.946		
N of Valid Cases	66				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.86.

b. Computed only for a 2x2 table

Figure 3.66. Chi-square test for Effect of LMS Quartile on MCI- Potential Improvement

LMS_25 * Potential_Improvement_Change_String Crosstabulation

Count

		Potential_Improvement_Change_String		
		Decreased	Increased	Total
LMS_25	Bottom 25%	12	13	25
	Top 25%	17	21	38
Total		29	34	63

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.065[a]	1	.799		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.065	1	.799		
Fisher's Exact Test				1.000	.501
Linear-by-Linear Association	.064	1	.801		
N of Valid Cases	63				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.51.

b. Computed only for a 2x2 table

Figure 3.67. Chi-square test for effect of LMS Quartile on MCI- Effort Utility

LMS_25 * Effort_Utility_Change_String Crosstabulation

Count

		Effort_Utility_Change_String		
		Decreased	Increased	Total
LMS_25	Bottom 25%	19	9	28
	Top 25%	22	13	35
Total		41	22	63

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.171[a]	1	.679		
Continuity Correction[b]	.022	1	.883		
Likelihood Ratio	.172	1	.679		
Fisher's Exact Test				.792	.443
Linear-by-Linear Association	.168	1	.682		
N of Valid Cases	63				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.78.

b. Computed only for a 2x2 table

Figure 3.68. Chi-square test for effect of LMS Quartile on MCI- Independence

LMS_25 * Independence_Change_String Crosstabulation

Count

		Independence_Change_String		
		Decreased	Increased	Total
LMS_25	Bottom 25%	14	13	27
	Top 25%	26	14	40
Total		40	27	67

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.158[a]	1	.282		
Continuity Correction[b]	.676	1	.411		
Likelihood Ratio	1.155	1	.283		
Fisher's Exact Test				.318	.205
Linear-by-Linear Association	1.141	1	.285		
N of Valid Cases	67				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.88.

b. Computed only for a 2x2 table

Figure 3.69. Chi-square test for effect of LMS Quartile on MCI- Inevitable Decrement

LMS_25 * Inev_Decrement_Change_String Crosstabulation

Count

		Inev_Decrement_Change_String		
		Decreased	Increased	Total
LMS_25	Bottom 25%	15	15	30
	Top 25%	18	20	38
Total		33	35	68

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.046[a]	1	.829		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.046	1	.829		
Fisher's Exact Test				1.000	.511
Linear-by-Linear Association	.046	1	.831		
N of Valid Cases	68				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.56.

b. Computed only for a 2x2 table

Figure 3.70. Chi-square test for effect of LMS Quartile on MCI- Alzheimer's Likelihood

LMS_25 * Alz_Change_String Crosstabulation

Count

		Alz_Change_String		
		Decreased	Increased	Total
LMS_25	Bottom 25%	15	16	31
	Top 25%	20	18	38
Total		35	34	69

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.123[a]	1	.726		
Continuity Correction[b]	.012	1	.913		
Likelihood Ratio	.123	1	.726		
Fisher's Exact Test				.811	.457
Linear-by-Linear Association	.121	1	.728		
N of Valid Cases	69				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.28.

b. Computed only for a 2x2 table

Figure 3.71. Chi-square test for effect of LMS Quartile on BTACT - Red-Green Accuracy Test Improvement

LMS_25 * Change_RGA_String Crosstabulation

Count

		Change_RGA_String		
		Decreased	Increased	Total
LMS_25	Bottom 25%	9	7	16
	Top 25%	12	10	22
Total		21	17	38

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.011[a]	1	.917		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.011	1	.917		
Fisher's Exact Test				1.000	.590
Linear-by-Linear Association	.011	1	.918		
N of Valid Cases	38				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.16.

b. Computed only for a 2x2 table

Figure 3.72. Chi-square test for effect of LMS Quartile on BTACT - Category Fluency Improvement

LMS_25 * Change_CF_Unique_String Crosstabulation

Count

		Change_CF_Unique_String		
		Decreased	Increased	Total
LMS_25	Bottom 25%	11	21	32
	Top 25%	17	27	44
Total		28	48	76

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.145[a]	1	.704		
Continuity Correction[b]	.019	1	.889		
Likelihood Ratio	.145	1	.703		
Fisher's Exact Test				.811	.446
Linear-by-Linear Association	.143	1	.706		
N of Valid Cases	76				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.79.

b. Computed only for a 2x2 table

Figure 3.73. Chi-square test for effect of LMS Quartile on BTACT- Word List Recall (Delay) Improvement

LMS_25 * Change_WLR_D_Unique_String Crosstabulation

Count

		Change_WLR_D_Unique_String		
		Decreased	Increased	Total
LMS_25	Bottom 25%	14	13	27
	Top 25%	20	21	41
Total		34	34	68

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.061[a]	1	.804		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.061	1	.804		
Fisher's Exact Test				1.000	.500
Linear-by-Linear Association	.061	1	.806		
N of Valid Cases	68				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.50.

b. Computed only for a 2x2 table

Figure 3.74. Chi-square test for effect of LMS Quartile on BTACT - Digit Span Improvement

LMS_25 * Change_DigitSpan_String Crosstabulation

Count

		Change_DigitSpan_String		
		Decreased	Increased	Total
LMS_25	Bottom 25%	9	10	19
	Top 25%	10	17	27
Total		19	27	46

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.491[a]	1	.483		
Continuity Correction[b]	.157	1	.692		
Likelihood Ratio	.490	1	.484		
Fisher's Exact Test				.552	.345
Linear-by-Linear Association	.480	1	.488		
N of Valid Cases	46				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.85.

b. Computed only for a 2x2 table

Figure 3.75. Chi-square test for effect of Memory Concern Quartile (Top and Bottom 25%) on Subjective Memory Performance

Concern_Quartiles * Lapses_Change_String Crosstabulation

Count

		Lapses_Change_String		
		Decreases	Increases	Total
Concern_Quartiles	Least concern	34	12	46
	Most concern	28	21	49
Total		62	33	95

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.943[a]	1	.086		
Continuity Correction[b]	2.250	1	.134		
Likelihood Ratio	2.973	1	.085		
Fisher's Exact Test				.131	.066
Linear-by-Linear Association	2.912	1	.088		
N of Valid Cases	95				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.98.

b. Computed only for a 2x2 table

Figure 3.76. Chi-square test for effect of Memory Concern Quartile (Top and Bottom 25%) on MCI- Present Ability

Concern_Quartiles * Present_Ability_Change_String Crosstabulation

Count

		Present_Ability_Change_String		
		Decreased	Increased	Total
Concern_Quartiles	Least concern	17	22	39
	Most concern	19	32	51
Total		36	54	90

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.370[a]	1	.543		
Continuity Correction[b]	.153	1	.696		
Likelihood Ratio	.369	1	.544		
Fisher's Exact Test				.665	.348
Linear-by-Linear Association	.365	1	.546		
N of Valid Cases	90				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.60.

b. Computed only for a 2x2 table

Figure 3.77. Chi-square test for effect of Memory Concern Quartile (Top and Bottom 25%) on MCI- Potential Improvement

Concern_Quartiles * Potential_Improvement_Change_String Crosstabulation

Count

		Potential_Improvement_Change_String		
		Decreased	Increased	Total
Concern_Quartiles	Least concern	19	22	41
	Most concern	21	28	49
Total		40	50	90

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.110[a]	1	.740		
Continuity Correction[b]	.014	1	.906		
Likelihood Ratio	.110	1	.740		
Fisher's Exact Test				.832	.453
Linear-by-Linear Association	.109	1	.742		
N of Valid Cases	90				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.22.

b. Computed only for a 2x2 table

Figure 3.78. Chi-square test for effect of Memory Concern Quartile (Top and Bottom 25%) on MCI- Effort Utility

Concern_Quartiles * Effort_Utility_Change_String Crosstabulation

Count

		Effort_Utility_Change_String		
		Decreased	Increased	Total
Concern_Quartiles	Least concern	28	13	41
	Most concern	24	19	43
Total		52	32	84

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.386[a]	1	.239		
Continuity Correction[b]	.907	1	.341		
Likelihood Ratio	1.392	1	.238		
Fisher's Exact Test				.268	.170
Linear-by-Linear Association	1.369	1	.242		
N of Valid Cases	84				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.62.

b. Computed only for a 2x2 table

Figure 3.79. Chi-square test for effect of Memory Concern Quartile (Top and Bottom 25%) on MCI-Independence

Concern_Quartiles * Independence_Change_String Crosstabulation

Count

		Independence_Change_String		
		Decreased	Increased	Total
Concern_Quartiles	Least concern	22	20	42
	Most concern	32	17	49
Total		54	37	91

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.566[a]	1	.211		
Continuity Correction[b]	1.076	1	.300		
Likelihood Ratio	1.567	1	.211		
Fisher's Exact Test				.285	.150
Linear-by-Linear Association	1.549	1	.213		
N of Valid Cases	91				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 17.08.

b. Computed only for a 2x2 table

Figure 3.80. Chi-square test for effect of Memory Concern Quartile (Top and Bottom 25%) on MCI-Inevitable Decrement

Concern_Quartiles * Inev_Decrement_Change_String Crosstabulation

Count

		Inev_Decrement_Change_String		
		Decreased	Increased	Total
Concern_Quartiles	Least concern	20	23	43
	Most concern	20	28	48
Total		40	51	91

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.216[a]	1	.642		
Continuity Correction[b]	.064	1	.800		
Likelihood Ratio	.216	1	.642		
Fisher's Exact Test				.677	.400
Linear-by-Linear Association	.214	1	.644		
N of Valid Cases	91				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.90.

b. Computed only for a 2x2 table

Figure 3.81. Chi-square test for effect of Memory Concern Quartile (Top and Bottom 25%) on MCI-Alzheimer's Likelihood

Concern_Quartiles * Alz_Change_String Crosstabulation

Count

		Alz_Change_String		
		Decreased	Increased	Total
Concern_Quartiles	Least concern	26	21	47
	Most concern	23	30	53
Total		49	51	100

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.417[a]	1	.234		
Continuity Correction[b]	.980	1	.322		
Likelihood Ratio	1.420	1	.233		
Fisher's Exact Test				.316	.161
Linear-by-Linear Association	1.403	1	.236		
N of Valid Cases	100				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 23.03.

b. Computed only for a 2x2 table

Figure 3.82. Chi-square test for effect of Memory Concern Quartile (Top and Bottom 25%) on BTACT- Category Fluency

Concern_Quartiles * Change_CF_Unique_String Crosstabulation

Count

		Change_CF_Unique_String		
		Decreased	Increased	Total
Concern_Quartiles	Least concern	25	26	51
	Most concern	25	30	55
Total		50	56	106

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.135[a]	1	.713		
Continuity Correction[b]	.030	1	.863		
Likelihood Ratio	.135	1	.713		
Fisher's Exact Test				.846	.431
Linear-by-Linear Association	.134	1	.715		
N of Valid Cases	106				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 24.06.

b. Computed only for a 2x2 table

Figure 3.83. Chi-square test for effect of Memory Concern Quartile (Top and Bottom 25%) on BTACT- Word List Recall (Delay)

Concern_Quartiles * Change_WLR_D_Unique_String Crosstabulation

Count

		Change_WLR_D_Unique_String		
		Decreased	Increased	Total
Concern_Quartiles	Least concern	20	28	48
	Most concern	19	23	42
Total		39	51	90

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.116[a]	1	.733		
Continuity Correction[b]	.016	1	.898		
Likelihood Ratio	.116	1	.733		
Fisher's Exact Test				.832	.449
Linear-by-Linear Association	.115	1	.734		
N of Valid Cases	90				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.20.

b. Computed only for a 2x2 table

Figure 3.84. Chi-square test for effect of Memory Concern Quartile (Top and Bottom 25%) on BTACT- Digit Span

Concern_Quartiles * Change_DigitSpan_String Crosstabulation

Count

		Change_DigitSpan_String		
		Decreased	Increased	Total
Concern_Quartiles	Least concern	13	20	33
	Most concern	19	12	31
Total		32	32	64

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.065[a]	1	.080		
Continuity Correction[b]	2.252	1	.133		
Likelihood Ratio	3.091	1	.079		
Fisher's Exact Test				.133	.066
Linear-by-Linear Association	3.018	1	.082		
N of Valid Cases	64				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.50.

b. Computed only for a 2x2 table

Figure 3.85. Fisher's Exact test for effect of Memory Concern Quartile (Top and Bottom 25%) on BTACT- Red-Green Accuracy Test

Concern_Quartiles * Change_RGA_String Crosstabulation

Count

		Change_RGA_String		
		Decreased	Increased	Total
Concern_Quartiles	Least concern	7	14	21
	Most concern	19	10	29
Total		26	24	50

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.055[a]	1	.025		
Continuity Correction[b]	3.847	1	.050		
Likelihood Ratio	5.138	1	.023		
Fisher's Exact Test				.044	.024
Linear-by-Linear Association	4.953	1	.026		
N of Valid Cases	50				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.08.

b. Computed only for a 2x2 table

Appendix B: Supplementary Analyses for Pain Study

Full Analyses for MHLC-Internal.

A one-way ANOVA revealed that there were no significant differences among the three group means on MHLC-Internal scores at baseline, $F(2, 153) = .14$, $p = .87$ (see Appendix D, Figure 12.1).

Next we conducted our primary analysis, a one-way ANCOVA, which revealed the following: As expected, the covariate, MHLC-Internal scores at baseline, was significantly related to the follow-up MHLC-Internal scores ($F(1,152) = 170.93$, $p < .001$, partial $\eta^2 = .53$; see Appendix B, Figure 12.2). After adjusting for pre-intervention scores of MHLC-Internal, there was not a statistically significant difference in post-intervention scores among the three conditions, $F(2, 152) = .41$, $p = .67$, partial $\eta^2 = .005$. See Appendix D for the Estimated Marginal Means of the three conditions at T1 (Figures 12.3 and 12.4).

Paired-sample t-tests revealed the following: Participants' mean score did not change between baseline and follow for any of the groups (High Mindfulness Pain: $t(52) = 1.30$, $p = .20$; Low Mindfulness Pain: $t(47) = .51$, $p = .61$; General Mindfulness: $t(54) = -.88$, $p = .38$.

Full Analyses for PBAPI- "Pain as Mystery"

The data for this variable did not meet the statistical assumption that the error variances are homogenous, so we performed a reciprocal transformation on the dependent variable ("Pain as Mystery" at T1). A one-way ANOVA revealed that there were no significant differences among the three group means on the transformed "Pain as Mystery" scores at baseline, $F(2, 153) = .06$, $p = .95$.

Next we conducted our primary analysis, a one-way ANCOVA, which revealed the following: As expected, the covariate ("Pain as Mystery" scores at baseline) was significantly related to the follow-up "Pain as Mystery" scores ($F(1,135) = 16.18$, $p < .001$, partial $\eta^2 = .11$; see Appendix D, Figure 14.2). After adjusting for pre-intervention scores of the measure, there was not a statistically significant difference in post-intervention scores of "Pain as Mystery" among the three conditions, $F(2, 135) = .21$, $p = .81$, partial $\eta^2 = .003$ (Appendix D, Figures 14.3 and 14.4).

Paired-sample t-tests revealed the following: Participants' mean score did not change between baseline and follow for any of the groups (High Mindfulness Pain: $t(52) = 1.30$, $p = .20$; Low Mindfulness Pain: $t(47) = .59$, $p = .56$; General Mindfulness: $t(54) = .71$, $p = .48$).

Full Analyses for BPI- "Pain Right Now"

A one-way ANOVA revealed that there were no significant differences among the three group means on "Pain Right Now" scores at baseline, $F(2, 153) = 1.22$, $p = .30$ (see Appendix D, Figure 19.1).

Next we conducted our primary analysis, a one-way ANCOVA, which revealed the following: As expected, the covariate ("Pain Right Now" scores at baseline) was significantly related to the follow-up "Pain Right Now" scores ($F(1,152) = 45.42$, $p < .001$, partial $\eta^2 = .23$; see Appendix D, Figure 19.2). After adjusting for pre-intervention scores of the measure, there was not a statistically significant difference in post-intervention scores among the three conditions, $F(2, 152) = .65$, $p = .52$, partial $\eta^2 = .008$ (Appendix D, Figure 19.3 and 19.4).

Paired-sample t-tests revealed that none of the groups significantly changed on this measure (High Mindfulness Pain group, $t(52) = -.092$, $p = .92$; Low Mindfulness Pain group, $t(47) = .36$, $p = .72$; General Mindfulness group: $t(54) = -1.14$, $p = .26$).

Full Analyses for PCS- Helplessness

First we checked whether there were any significant baseline differences of "Helplessness" scores among the three conditions. A one-way ANOVA revealed that there were no significant differences among the three group means on "Helplessness" scores at baseline, $F(2, 153) = 1.82$, $p = .17$ (see Appendix D, Figure 22.1).

Next we conducted our primary analysis, a one-way ANCOVA to determine if there were differences in "Helplessness" scores at T1 among the three study conditions, taking into account the baseline scores. As expected, the covariate (scores at baseline) was significantly related to the follow-up scores ($F(1,152) = 127.04$, $p < .001$, partial $\eta^2 = .46$; see Appendix D, Figure 22.2). After adjusting for pre-intervention scores of the measure, we did not find a statistically significant difference in post-intervention scores among the three conditions, $F(2, 152) = .61$, $p = .53$, partial $\eta^2 = .008$ (Appendix D, Figures 22.3 and 22.4).

Paired-sample t-tests revealed that none of the groups significantly changed on this measure from baseline to follow-up (High Mindfulness Pain condition: $t(52)= 1.10$, $p= .28$; Low Mindfulness Pain condition: $t(47)= 1.00$, $p= .32$; General Mindfulness condition: $t(53)= -1.73$, $p = .38$).

Figure 4.0. Homogeneity of Regression Slopes for MHLC "Internal"

Tests of Between-Subjects Effects

Dependent Variable: MHLC_Internal.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3439.915[a]	5	687.983	34.525	.000
Intercept	463.722	1	463.722	23.271	.000
Condition	26.511	2	13.255	.665	.516
MHLC_Internal.1	3333.564	1	3333.564	167.290	.000
Condition * MHLC_Internal.1	29.304	2	14.652	.735	.481
Error	2989.027	150	19.927		
Total	54099.000	156			
Corrected Total	6428.942	155			

a. R Squared = .535 (Adjusted R Squared = .520)

Figure 4.1. Homogeneity of Regression Slopes for MHLC "Chance"

Tests of Between-Subjects Effects

Dependent Variable: MHLC_Chance.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3164.706[a]	5	632.941	27.158	.000
Intercept	807.754	1	807.754	34.659	.000
Condition	138.719	2	69.360	2.976	.054
MHLC_Chance.1	2895.274	1	2895.274	124.229	.000
Condition * MHLC_Chance.1	138.417	2	69.208	2.970	.054
Error	3495.884	150	23.306		
Total	65668.000	156			
Corrected Total	6660.590	155			

a. R Squared = .475 (Adjusted R Squared = .458)

Figure 4.2. Homogeneity of Regression Slopes for MHLC "Doctors"

Tests of Between-Subjects Effects

Dependent Variable: MHLC_Doctors.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	805.515[a]	5	161.103	23.899	.000
Intercept	438.899	1	438.899	65.108	.000
Condition	35.549	2	17.774	2.637	.075
MHLC_Doctors.1	778.202	1	778.202	115.441	.000
Condition * MHLC_Doctors.1	25.647	2	12.824	1.902	.153
Error	1011.171	150	6.741		
Total	22287.000	156			
Corrected Total	1816.686	155			

a. R Squared = .443 (Adjusted R Squared = .425)

Figure 4.3. Homogeneity of Regression Slopes for PBAPI "Pain as Mystery"

Tests of Between-Subjects Effects

Dependent Variable: Pain_As_Mystery.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	48.678[a]	5	9.736	11.907	.000
Intercept	3.562	1	3.562	4.357	.039
Condition	.323	2	.161	.197	.821
Pain_As_Mystery.1	48.105	1	48.105	58.836	.000
Condition * Pain_As_Mystery.1	2.251	2	1.125	1.376	.256
Error	122.644	150	.818		
Total	176.438	156			
Corrected Total	171.322	155			

a. R Squared = .284 (Adjusted R Squared = .260)

Figure 4.4. Homogeneity of Regression Slopes for PBAPI "Pain as Constant"

Tests of Between-Subjects Effects

Dependent Variable: Pain_As_Constant.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	34.272[a]	5	6.854	31.109	.000
Intercept	.482	1	.482	2.189	.141
Condition	.341	2	.171	.774	.463
Pain_As_Constant.1	33.425	1	33.425	151.699	.000
Condition * Pain_As_Constant.1	.743	2	.372	1.687	.189
Error	33.050	150	.220		
Total	81.083	156			
Corrected Total	67.322	155			

a. R Squared = .509 (Adjusted R Squared = .493)

Figure 4.5. Homogeneity of Regression Slopes for PBAPI "Pain as Permanent"

Tests of Between-Subjects Effects

Dependent Variable: Pain_As_Permanent.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	88.153[a]	5	17.631	55.075	.000
Intercept	.151	1	.151	.472	.493
Condition	.951	2	.476	1.485	.230
Pain_As_Permanent.1	84.398	1	84.398	263.643	.000
Condition * Pain_As_Permanent.1	.562	2	.281	.878	.418
Error	48.018	150	.320		
Total	219.236	156			
Corrected Total	136.172	155			

a. R Squared = .647 (Adjusted R Squared = .636)

Figure 4.6. Homogeneity of Regression Slopes for PBAPI "Self-Blame"

Tests of Between-Subjects Effects

Dependent Variable: SelfBlame.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	57.620[a]	5	11.524	41.576	.000
Intercept	3.186	1	3.186	11.494	.001
Condition	2.487	2	1.244	4.486	.013
SelfBlame.1	57.089	1	57.089	205.964	.000
Condition * SelfBlame.1	1.698	2	.849	3.063	.050
Error	41.577	150	.277		
Total	238.188	156			
Corrected Total	99.197	155			

a. R Squared = .581 (Adjusted R Squared = .567)

Figure 4.7. Homogeneity of Regression Slopes for BPI – "Pain on Average"

Tests of Between-Subjects Effects

Dependent Variable: Pain_on_Average.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	123.430[a]	5	24.686	10.380	.000
Intercept	256.393	1	256.393	107.806	.000
Condition	4.011	2	2.006	.843	.432
Pain_on_Average.1	122.078	1	122.078	51.330	.000
Condition * Pain_on_Average.1	4.909	2	2.455	1.032	.359
Error	356.743	150	2.378		
Total	5847.000	156			
Corrected Total	480.173	155			

a. R Squared = .257 (Adjusted R Squared = .232)

Figure 4.8. Homogeneity of Regression Slopes for BPI – "Pain Right Now"

Tests of Between-Subjects Effects

Dependent Variable: S2_Pain_Right_Now

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	139.819[a]	5	27.964	4.848	.000
Intercept	260.176	1	260.176	45.108	.000
Condition	2.129	2	1.065	.185	.832
S1_Pain_Right_Now	117.001	1	117.001	20.285	.000
Condition * S1_Pain_Right_Now	3.152	2	1.576	.273	.761
Error	865.174	150	5.768		
Total	7275.000	156			
Corrected Total	1004.994	155			

a. R Squared = .139 (Adjusted R Squared = .110)

Figure 4.9. Homogeneity of Regression Slopes for Pain Interference

Tests of Between-Subjects Effects

Dependent Variable: Pain_Interference.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	357.902[a]	5	71.580	17.811	.000
Intercept	42.621	1	42.621	10.605	.001
Condition	24.780	2	12.390	3.083	.049
Pain_Interference.1	344.960	1	344.960	85.834	.000
Condition * Pain_Interference.1	29.233	2	14.616	3.637	.029
Error	602.838	150	4.019		
Total	7178.327	156			
Corrected Total	960.739	155			

a. R Squared = .373 (Adjusted R Squared = .352)

Figure 4.10. Homogeneity of Regression Slopes for PCS – "Rumination"

Tests of Between-Subjects Effects

Dependent Variable: S2_Rumination

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1555.014[a]	5	311.003	36.580	.000
Intercept	199.120	1	199.120	23.420	.000
Condition	24.719	2	12.359	1.454	.237
S1_Rumination	1382.532	1	1382.532	162.611	.000
Condition * S1_Rumination	14.186	2	7.093	.834	.436
Error	1275.313	150	8.502		
Total	21117.000	156			
Corrected Total	2830.327	155			

a. R Squared = .549 (Adjusted R Squared = .534)

Figure 4.11. Homogeneity of Regression Slopes for PCS – "Magnification"

Tests of Between-Subjects Effects

Dependent Variable: S2_Magnification

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	696.968[a]	5	139.394	38.722	.000
Intercept	92.108	1	92.108	25.587	.000
Condition	.119	2	.059	.016	.984
S1_Magnification	677.461	1	677.461	188.193	.000
Condition * S1_Magnification	4.281	2	2.140	.595	.553
Error	539.974	150	3.600		
Total	8839.000	156			
Corrected Total	1236.942	155			

a. R Squared = .563 (Adjusted R Squared = .549)

Figure 4.12. Homogeneity of Regression Slopes for PCS – "Helplessness"

Tests of Between-Subjects Effects

Dependent Variable: S2_Helplessness

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2382.379[a]	5	476.476	26.806	.000
Intercept	359.604	1	359.604	20.231	.000
Condition	40.361	2	20.181	1.135	.324
S1_Helplessness	2309.420	1	2309.420	129.927	.000
Condition * S1_Helplessness	68.027	2	34.014	1.914	.151
Error	2666.211	150	17.775		
Total	38080.000	156			
Corrected Total	5048.590	155			

a. R Squared = .472 (Adjusted R Squared = .454)

Figure 4.13. Test of Homogeneity of Error Variances for MHLC "Internal"

Levene's Test of Equality of Error Variances[a]

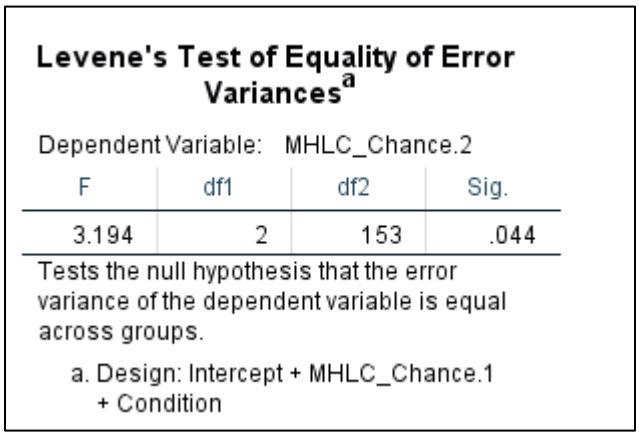
Dependent Variable: MHLC_Internal.2

F	df1	df2	Sig.
.394	2	153	.675

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MHLC_Internal.1 + Condition

Figure 4.14. Test of Homogeneity of Error Variances for MHLC "Chance"



Levene's Test of Equality of Error Variances[a]

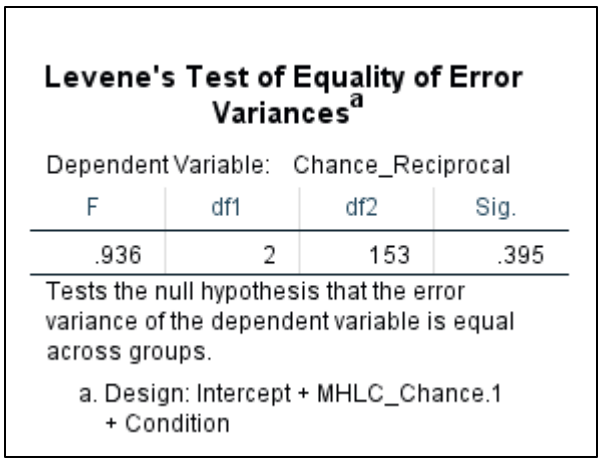
Dependent Variable: MHLC_Chance.2

F	df1	df2	Sig.
3.194	2	153	.044

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MHLC_Chance.1 + Condition

Figure 4.15. Test of Homogeneity of Error Variances for MHLC "Chance" (Transformed)



Levene's Test of Equality of Error Variances[a]

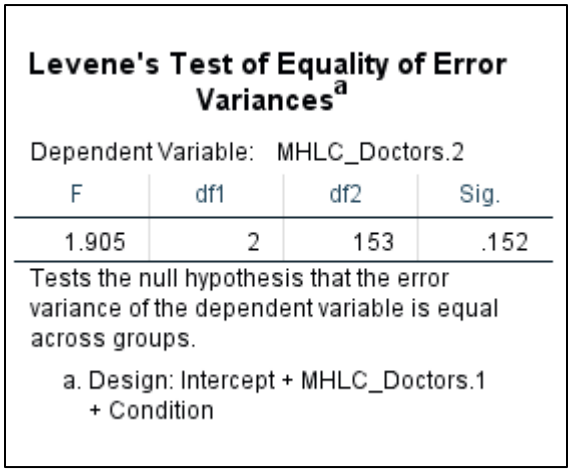
Dependent Variable: Chance_Reciprocal

F	df1	df2	Sig.
.936	2	153	.395

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MHLC_Chance.1 + Condition

Figure 4.16. Test of Homogeneity of Error Variances for MHLC "Doctors"



Levene's Test of Equality of Error Variances[a]

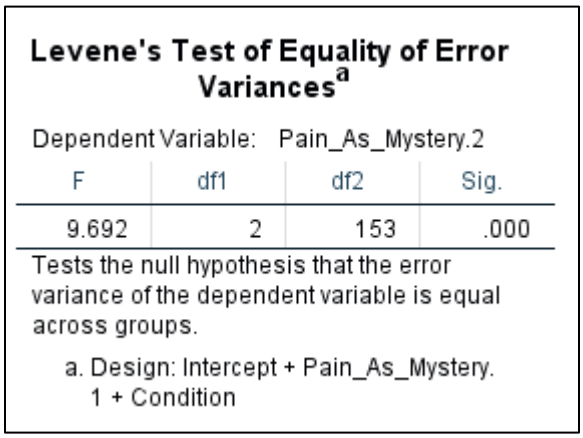
Dependent Variable: MHLC_Doctors.2

F	df1	df2	Sig.
1.905	2	153	.152

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + MHLC_Doctors.1 + Condition

Figure 4.17. Test of Homogeneity of Error Variances for PBAPI "Pain as Mystery"



Levene's Test of Equality of Error Variances[a]

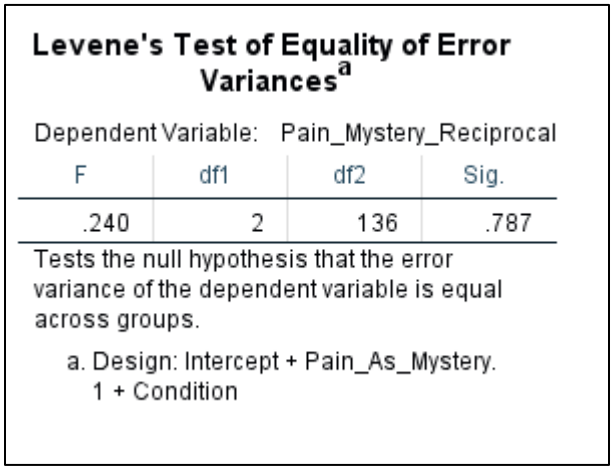
Dependent Variable: Pain_As_Mystery.2

F	df1	df2	Sig.
9.692	2	153	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Pain_As_Mystery. 1 + Condition

Figure 4.18. Test of Homogeneity of Error Variances for PBAPI "Pain as Mystery" (Transformed)



Levene's Test of Equality of Error Variances[a]

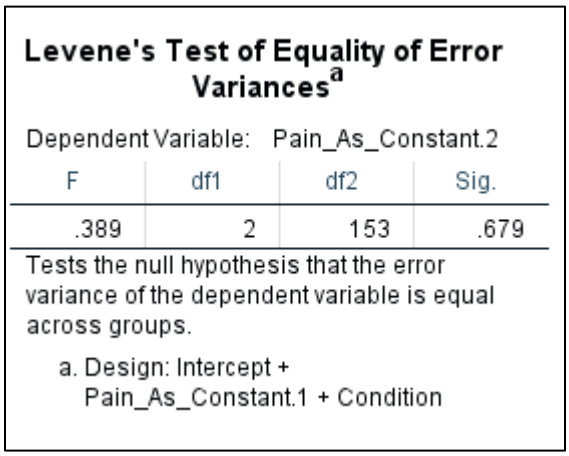
Dependent Variable: Pain_Mystery_Reciprocal

F	df1	df2	Sig.
.240	2	136	.787

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Pain_As_Mystery. 1 + Condition

Figure 4.19. Test of Homogeneity of Error Variances for PBAPI "Pain as Constant"



Levene's Test of Equality of Error Variances[a]

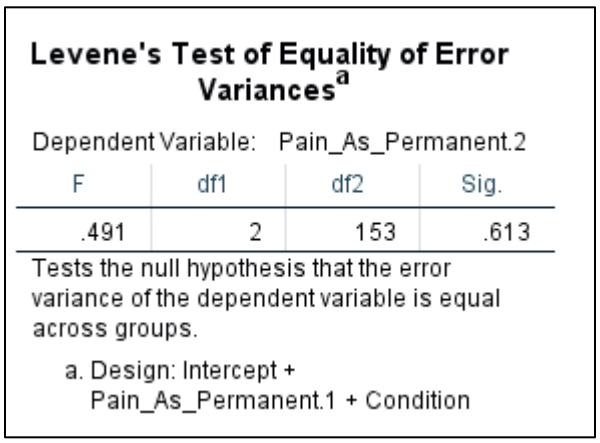
Dependent Variable: Pain_As_Constant.2

F	df1	df2	Sig.
.389	2	153	.679

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Pain_As_Constant.1 + Condition

Figure 4.20. Test of Homogeneity of Error Variances for PBAPI "Pain as Permanent"



Levene's Test of Equality of Error Variances[a]

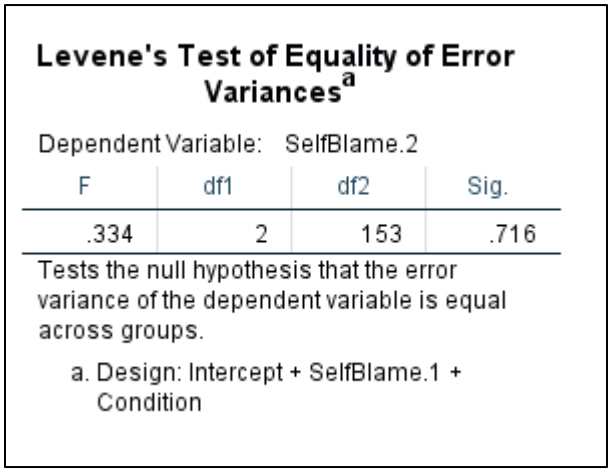
Dependent Variable: Pain_As_Permanent.2

F	df1	df2	Sig.
.491	2	153	.613

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Pain_As_Permanent.1 + Condition

Figure 4.21. Test of Homogeneity of Error Variances for PBAPI "Self-Blame"



Levene's Test of Equality of Error Variances[a]

Dependent Variable: SelfBlame.2

F	df1	df2	Sig.
.334	2	153	.716

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + SelfBlame.1 + Condition

Figure 4.22. Test of Homogeneity of Error Variances for BPI- "Pain on Average"

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Pain_on_Average.2

F	df1	df2	Sig.
.300	2	153	.741

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Pain_on_Average.1 + Condition

Figure 4.23. Test of Homogeneity of Error Variances for BPI- "Pain Right Now"

Levene's Test of Equality of Error Variances[a]

Dependent Variable: S2_Pain_Right_Now

F	df1	df2	Sig.
.654	2	153	.522

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + S1_Pain_Right_Now + Condition

Figure 4.24. Test of Homogeneity of Error Variances for PCS – "Rumination"

Levene's Test of Equality of Error Variances[a]

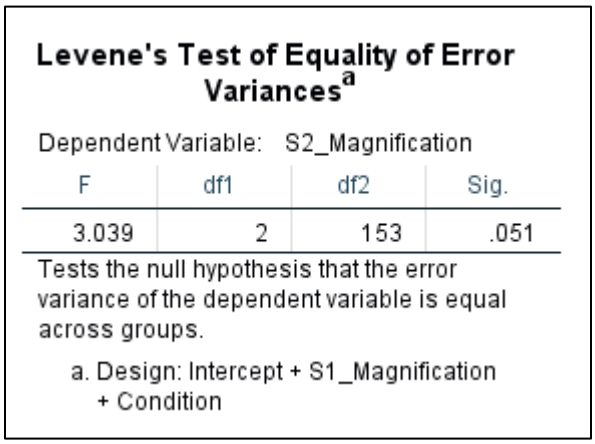
Dependent Variable: S2_Rumination

F	df1	df2	Sig.
2.461	2	153	.089

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + S1_Rumination + Condition

Figure 4.25. Test of Homogeneity of Error Variances for PCS – "Magnification"



Levene's Test of Equality of Error Variances[a]

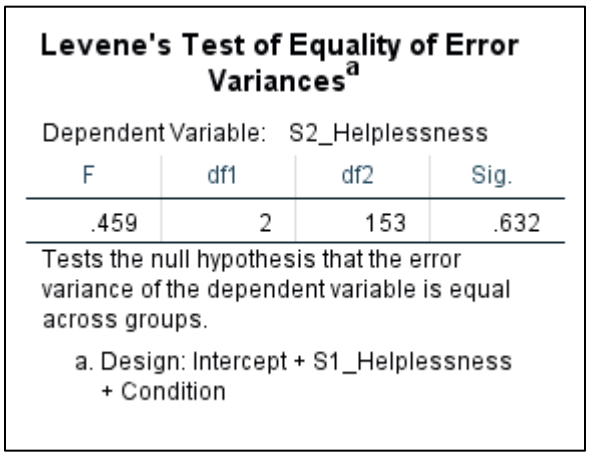
Dependent Variable: S2_Magnification

F	df1	df2	Sig.
3.039	2	153	.051

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + S1_Magnification + Condition

Figure 4.26. Test of Homogeneity of Error Variances for PCS – "Helplessness"



Levene's Test of Equality of Error Variances[a]

Dependent Variable: S2_Helplessness

F	df1	df2	Sig.
.459	2	153	.632

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + S1_Helplessness + Condition

Figure 4.27. Boxplot of MHLC – "Internal" Scores at T0

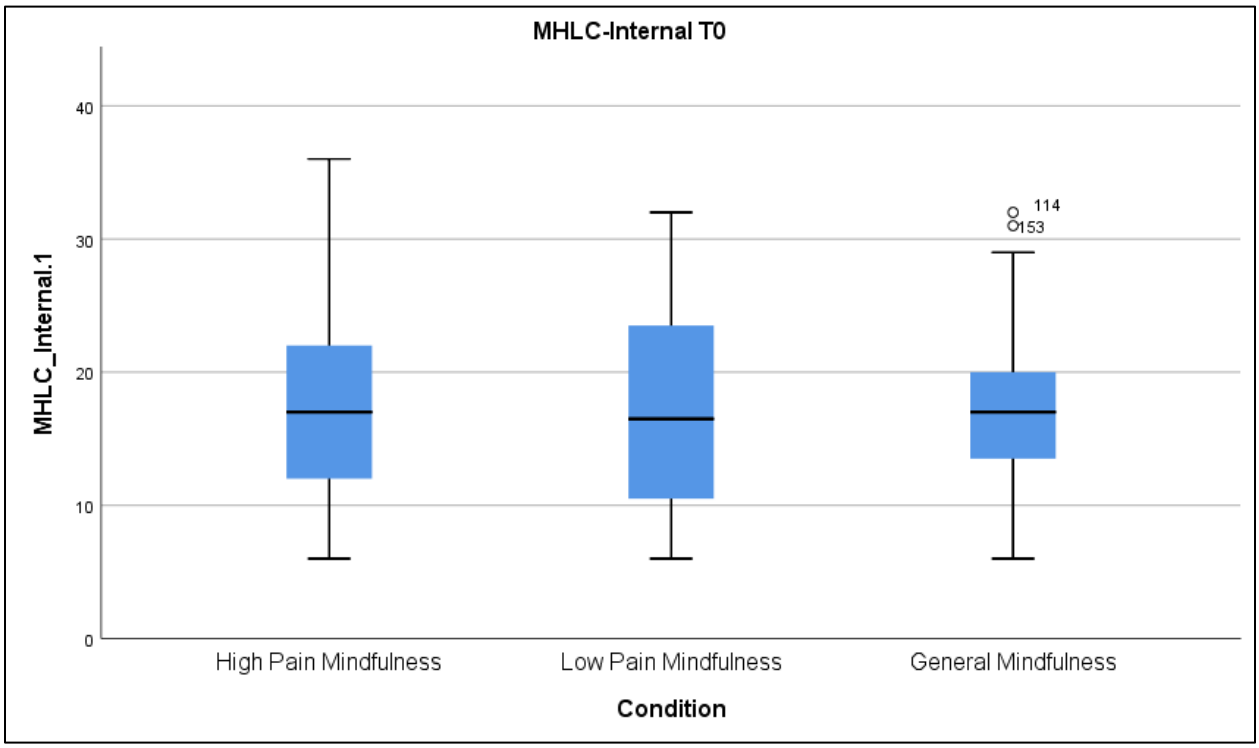


Figure 4.28. Boxplot of MHLC - "Internal" Scores at T1

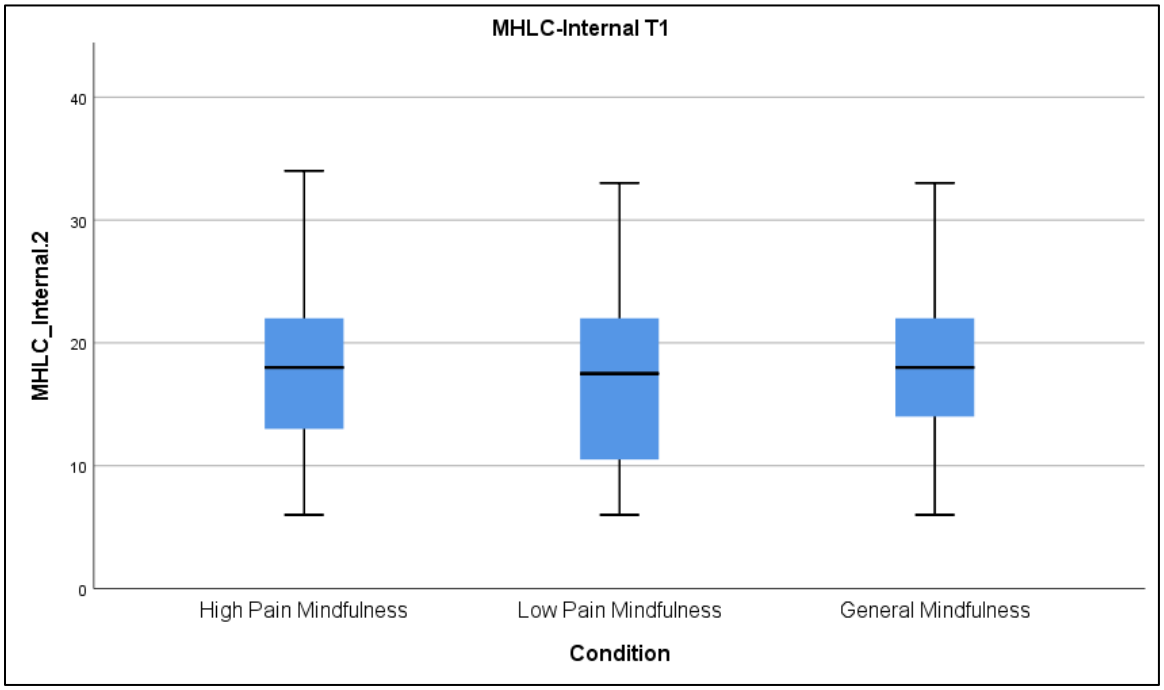


Figure 4.29. Boxplot of MHLC - "Chance" Scores at T0

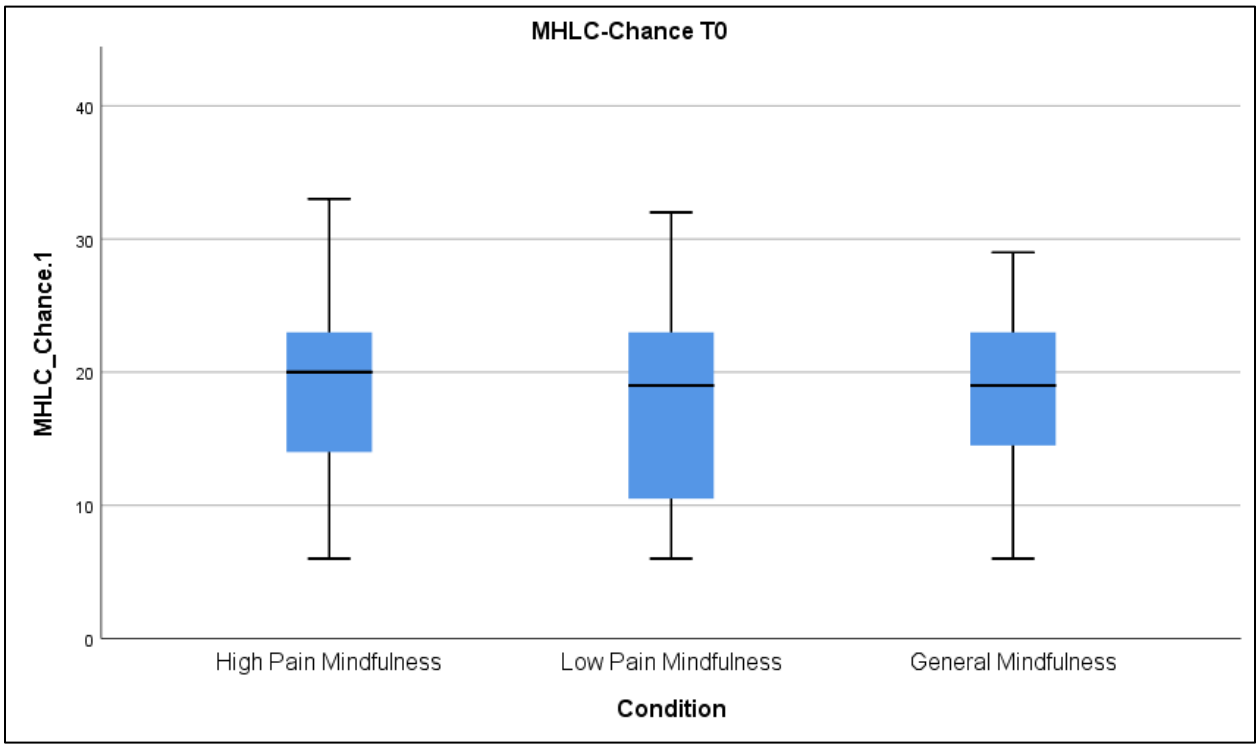


Figure 4.30. Boxplot of MHLC- "Chance" Scores at T1

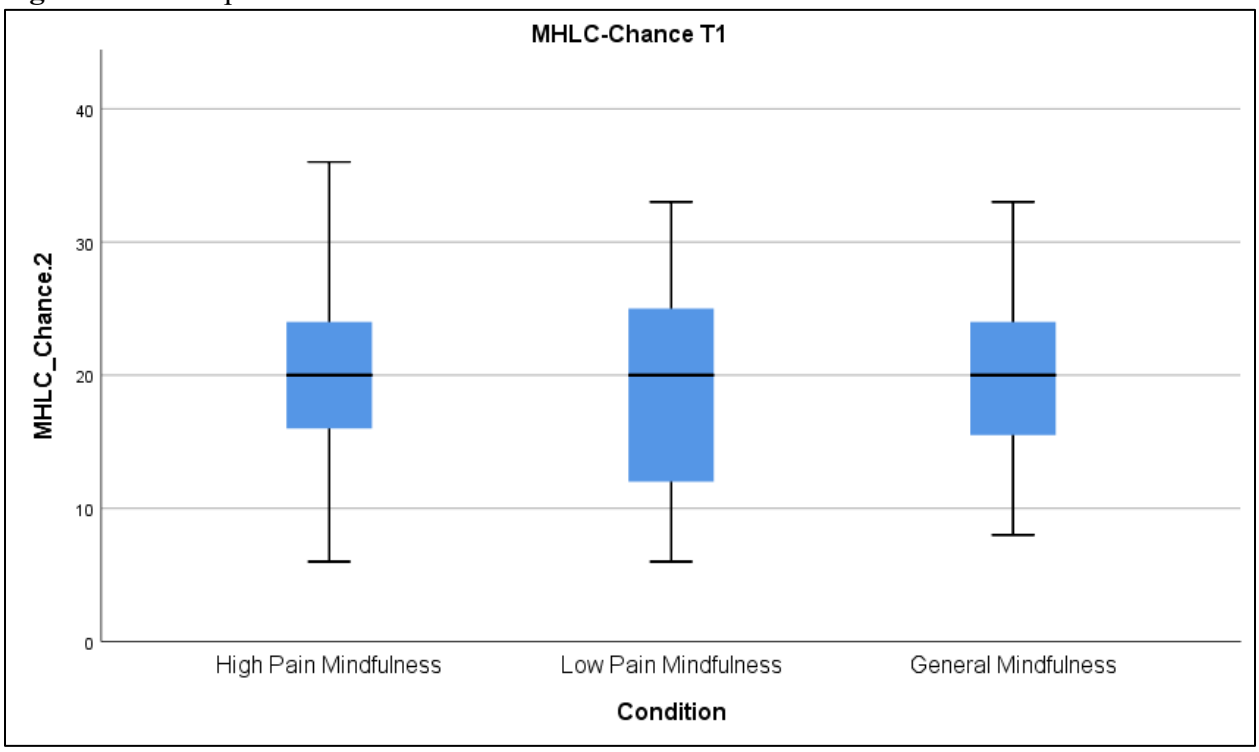


Figure 4.31. Boxplot of MHLC - "Doctors" Scores at T0

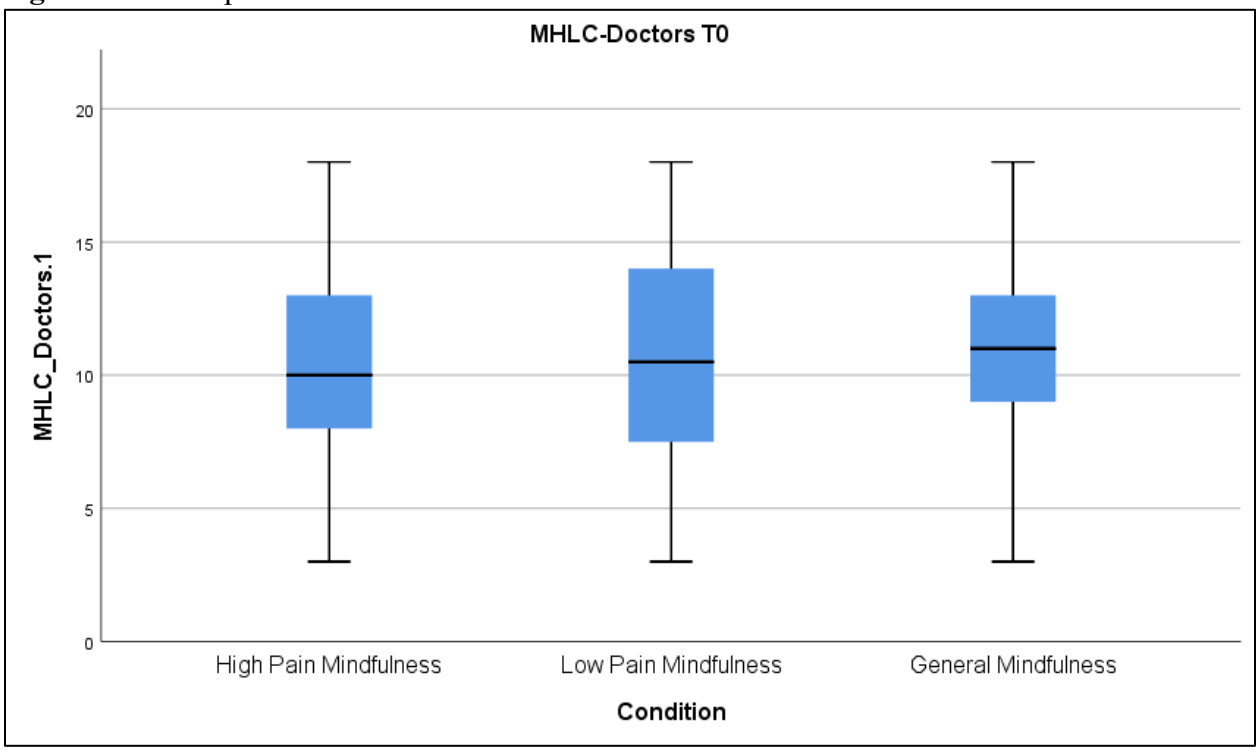


Figure 4.32. Boxplot of MHLC – "Doctors" Scores at T1

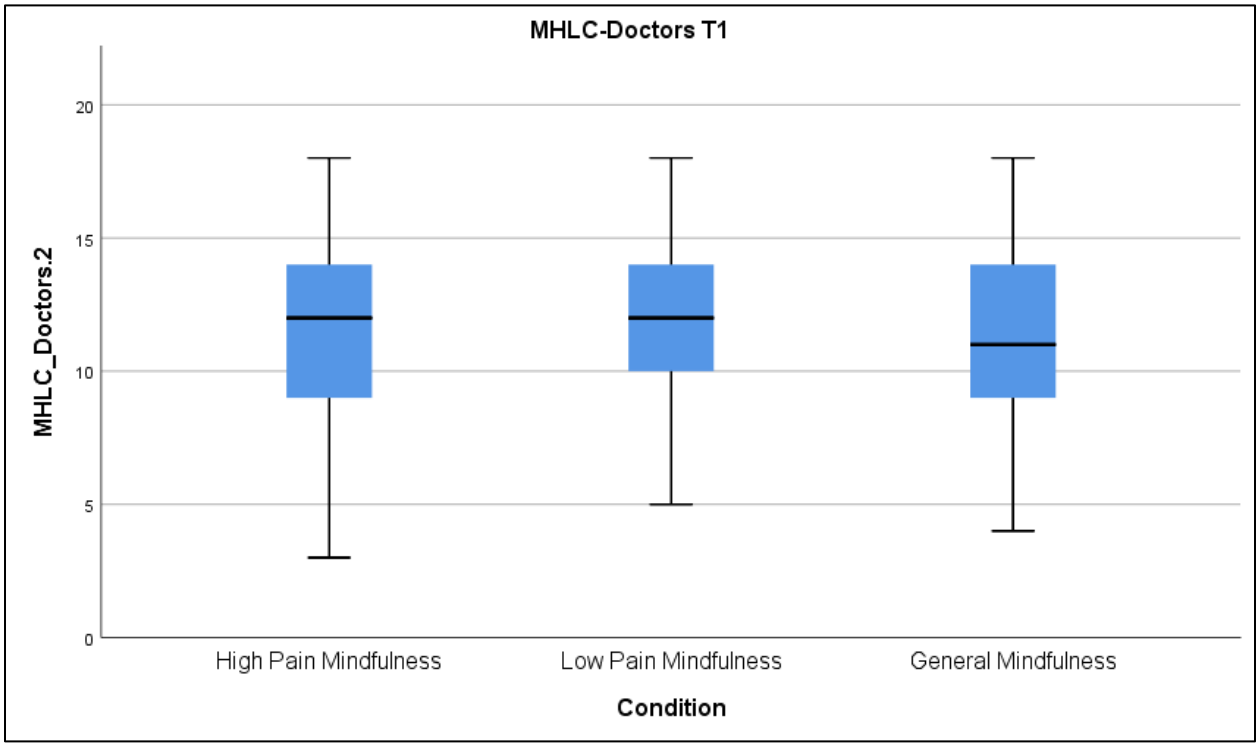


Figure 4.33. Boxplot of PBAPI – "Pain as Mystery" Scores at T0

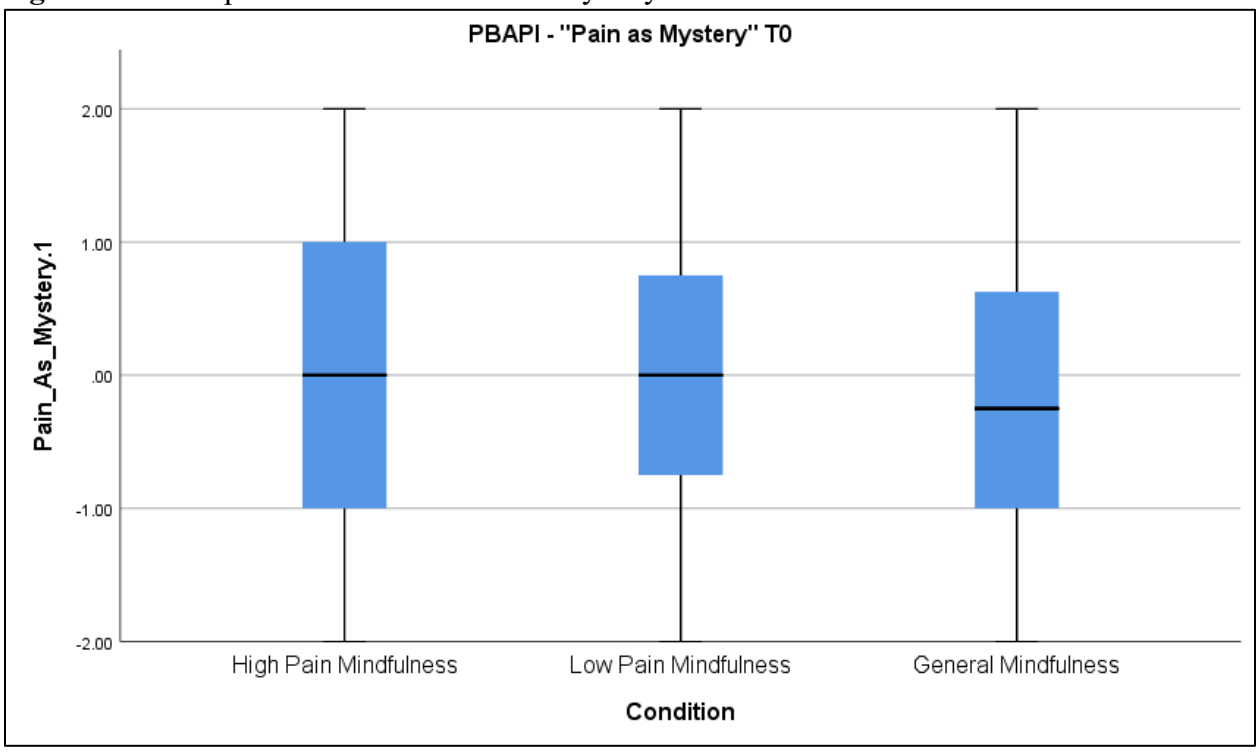


Figure 4.34. Boxplot of PBAPI – "Pain as Mystery" Scores at T1

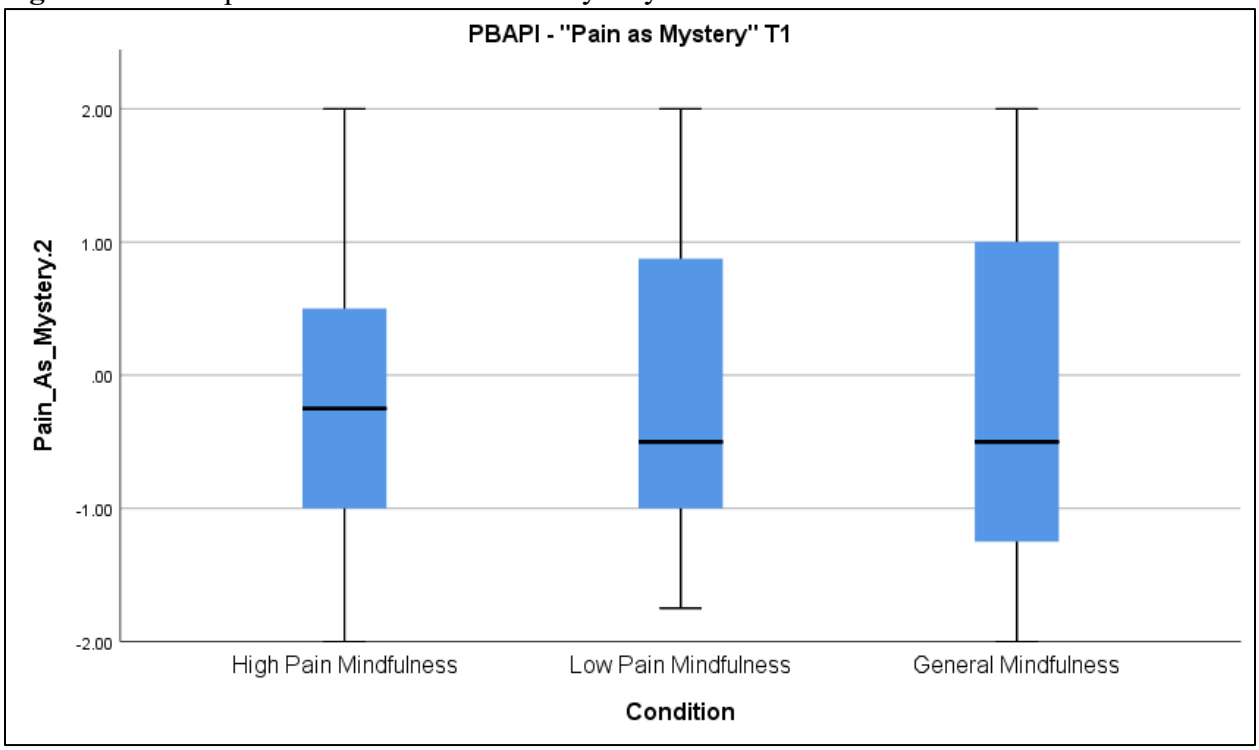


Figure 4.35. Boxplot of PBAPI – "Pain as Constant" Scores at T0

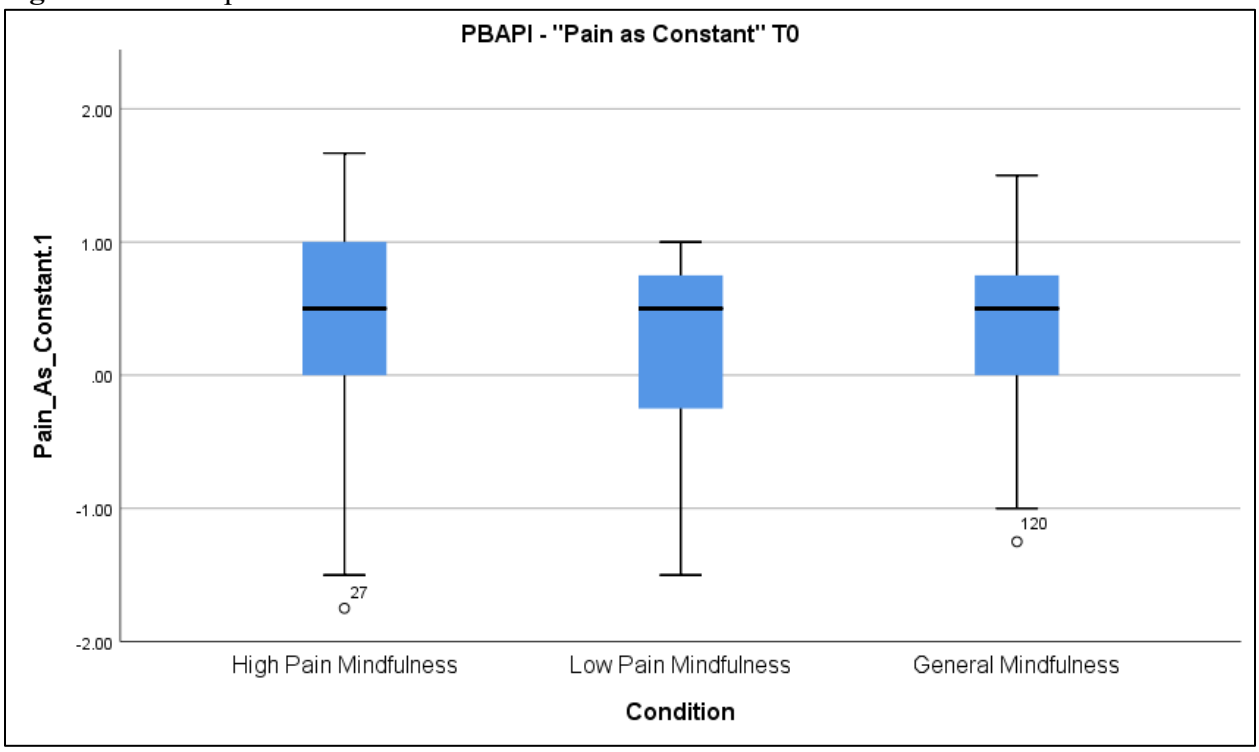


Figure 4.36. Boxplot of PBAPI – "Pain as Constant" Scores at T1

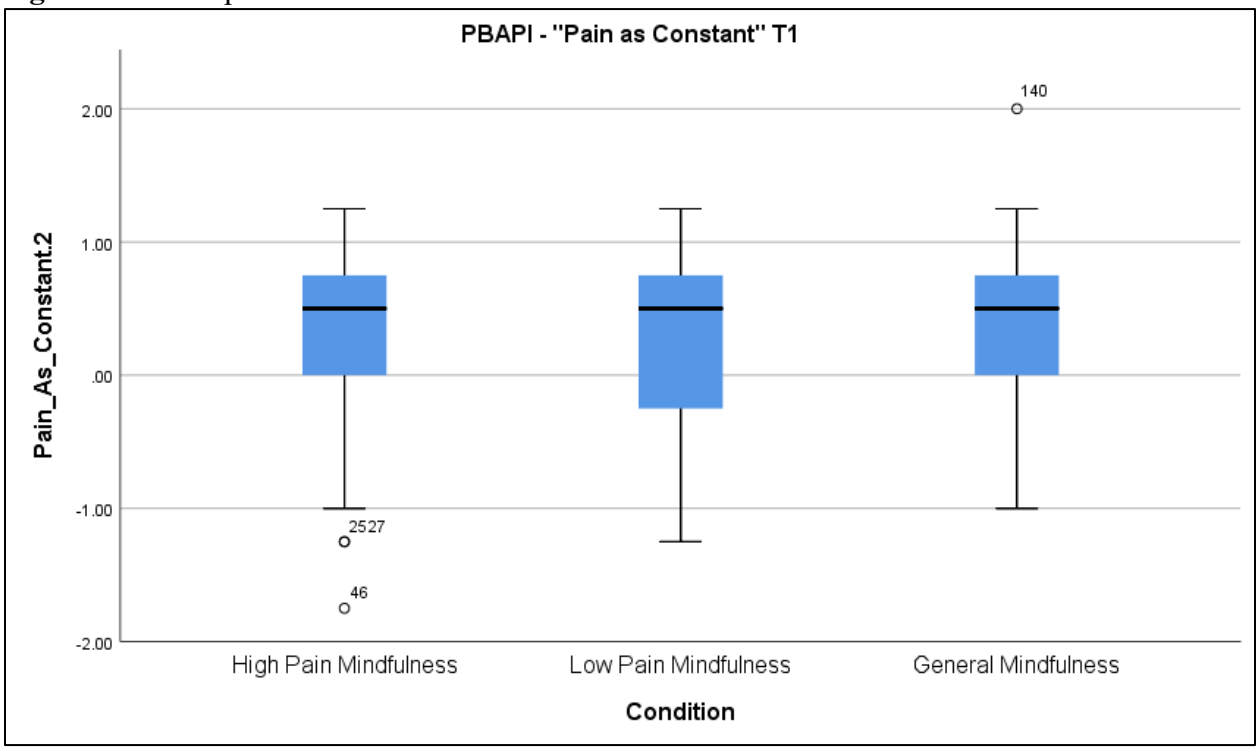


Figure 4.37. Boxplot of PBAPI – "Pain as Permanent" Scores at T0

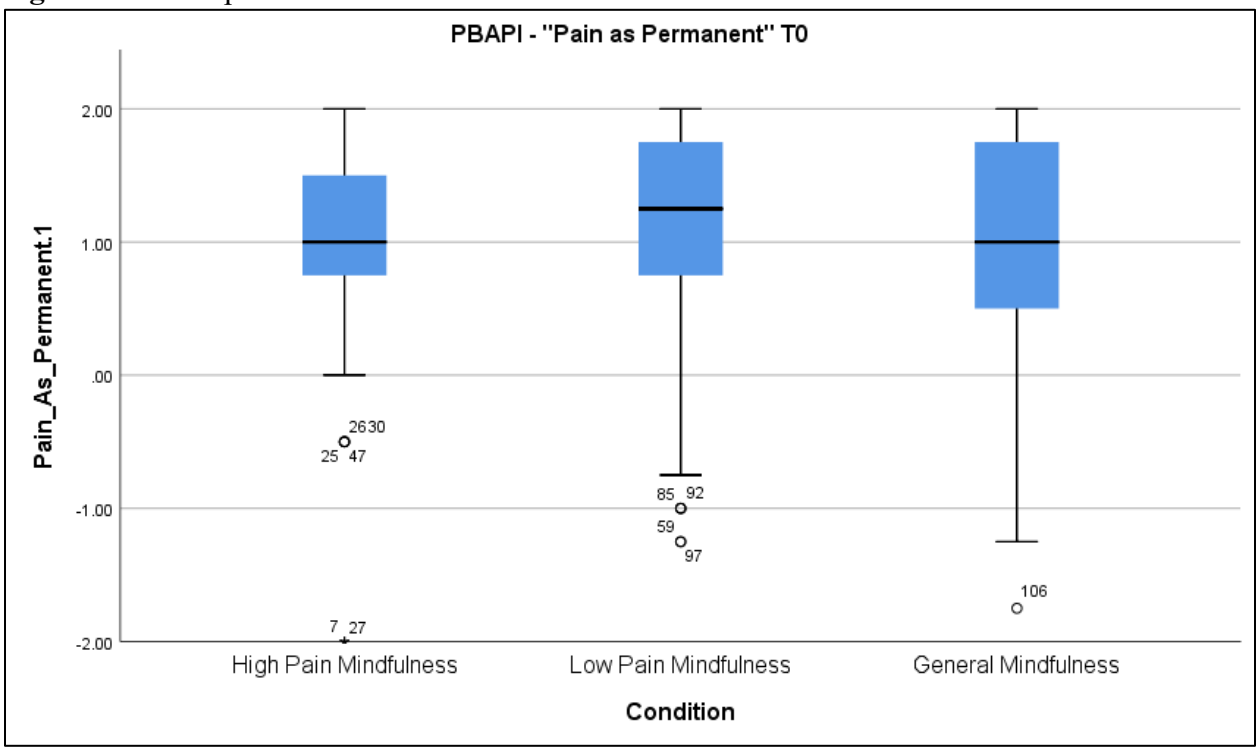


Figure 4.38. Boxplot of PBAPI – "Pain as Permanent" Scores at T1

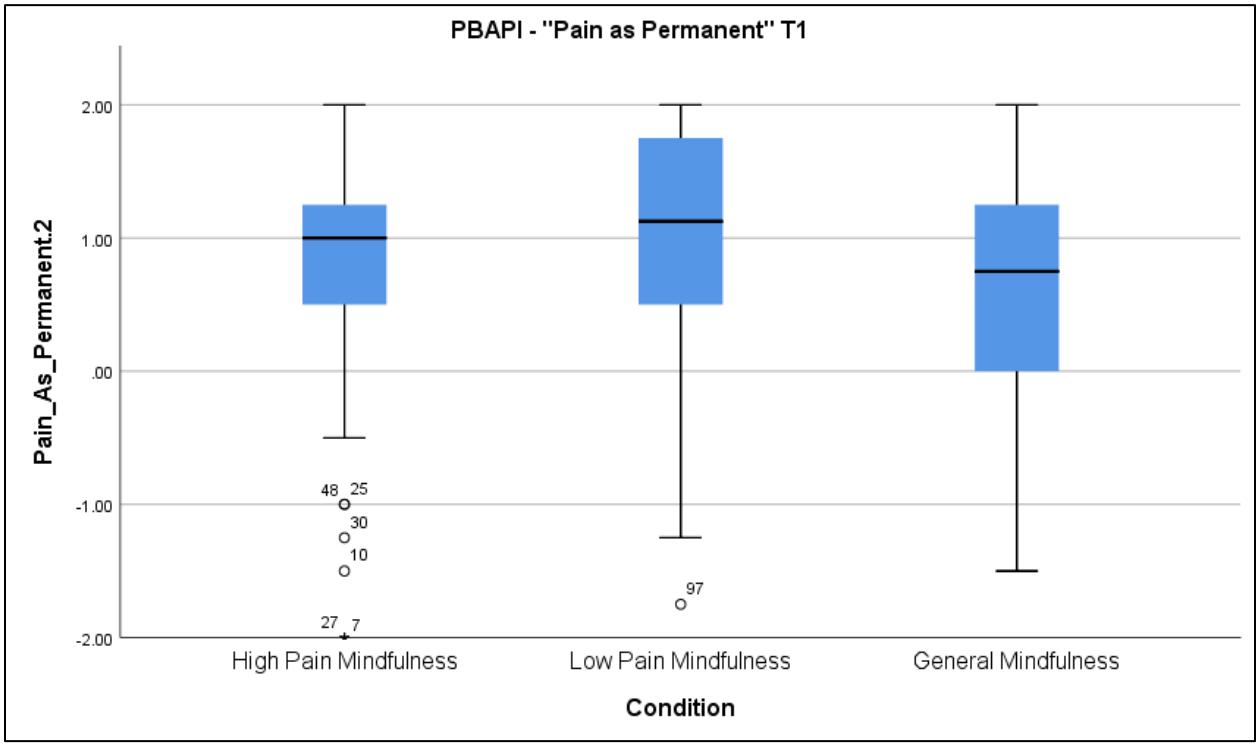


Figure 4.39. Boxplot of PBAPI – "Self-Blame" Scores at T0

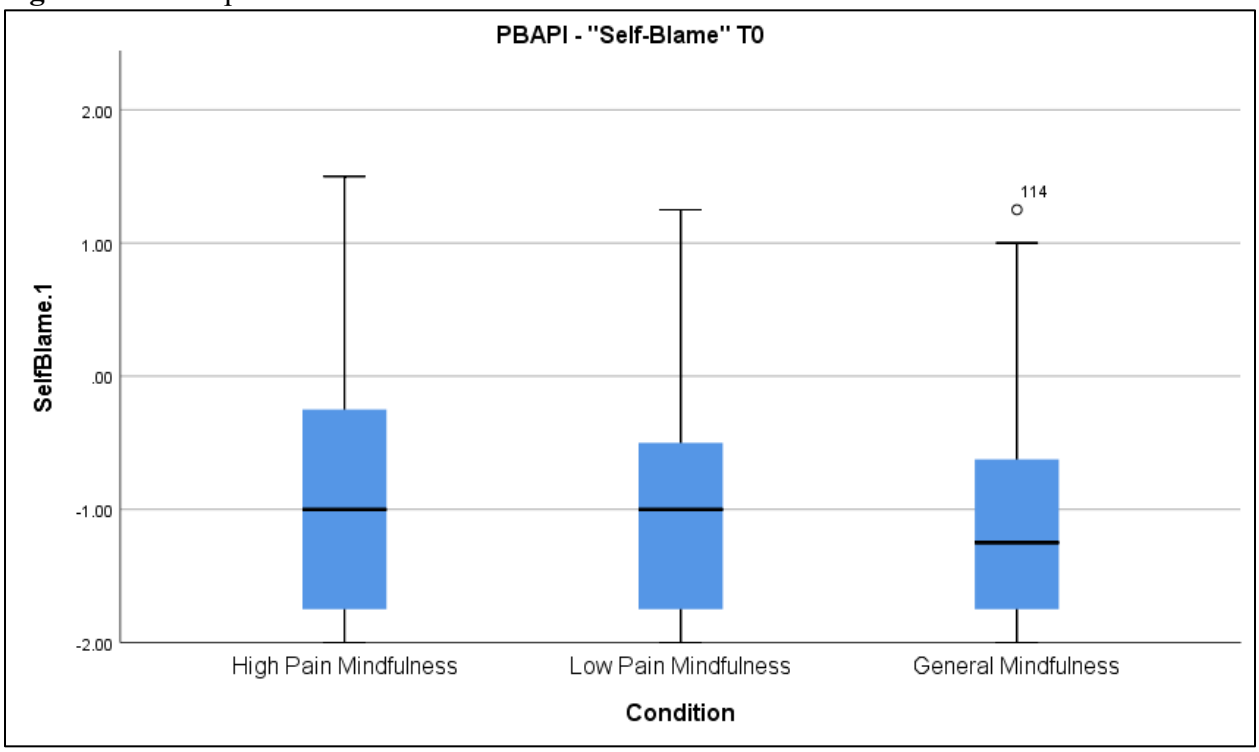


Figure 4.40. Boxplot of PBAPI – "Self-Blame" Scores at T1

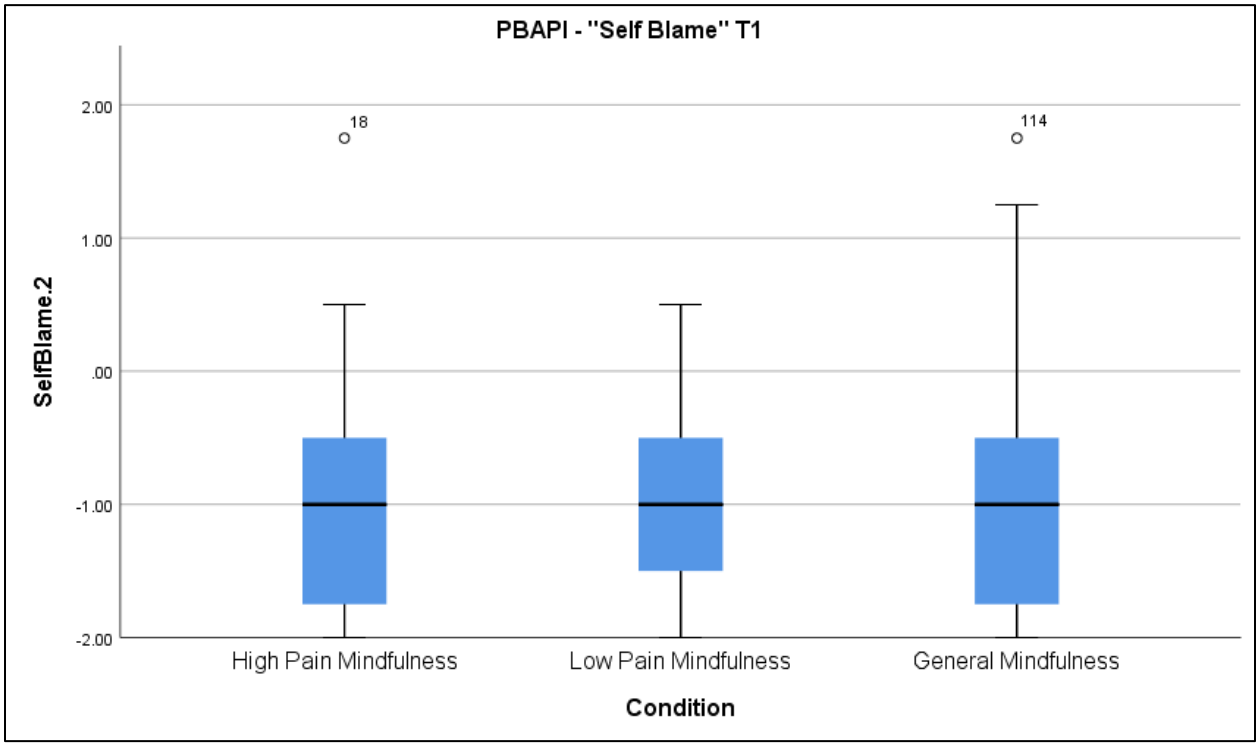


Figure 4.41. Boxplot of "Pain on Average" scores at T0

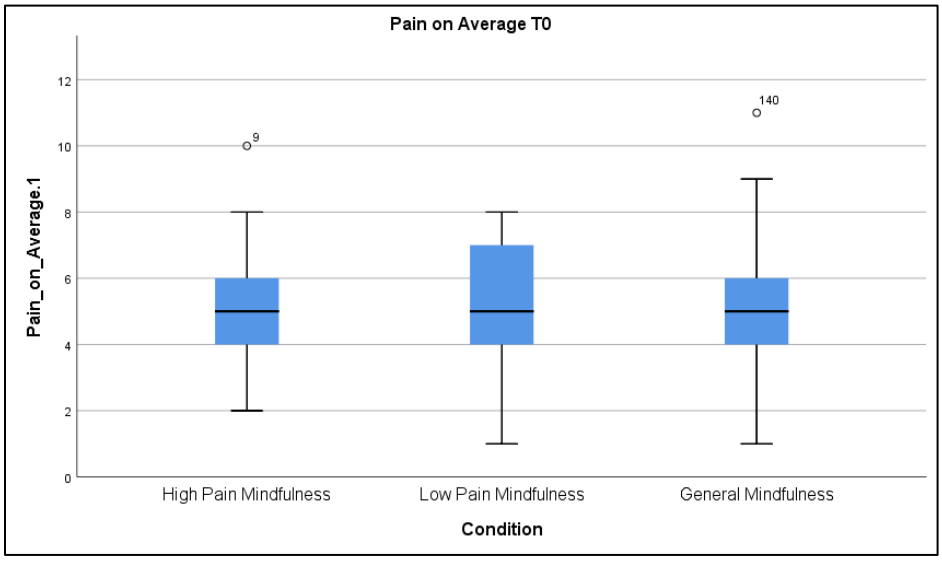


Figure 4.42. Boxplot of "Pain on Average" scores at T1

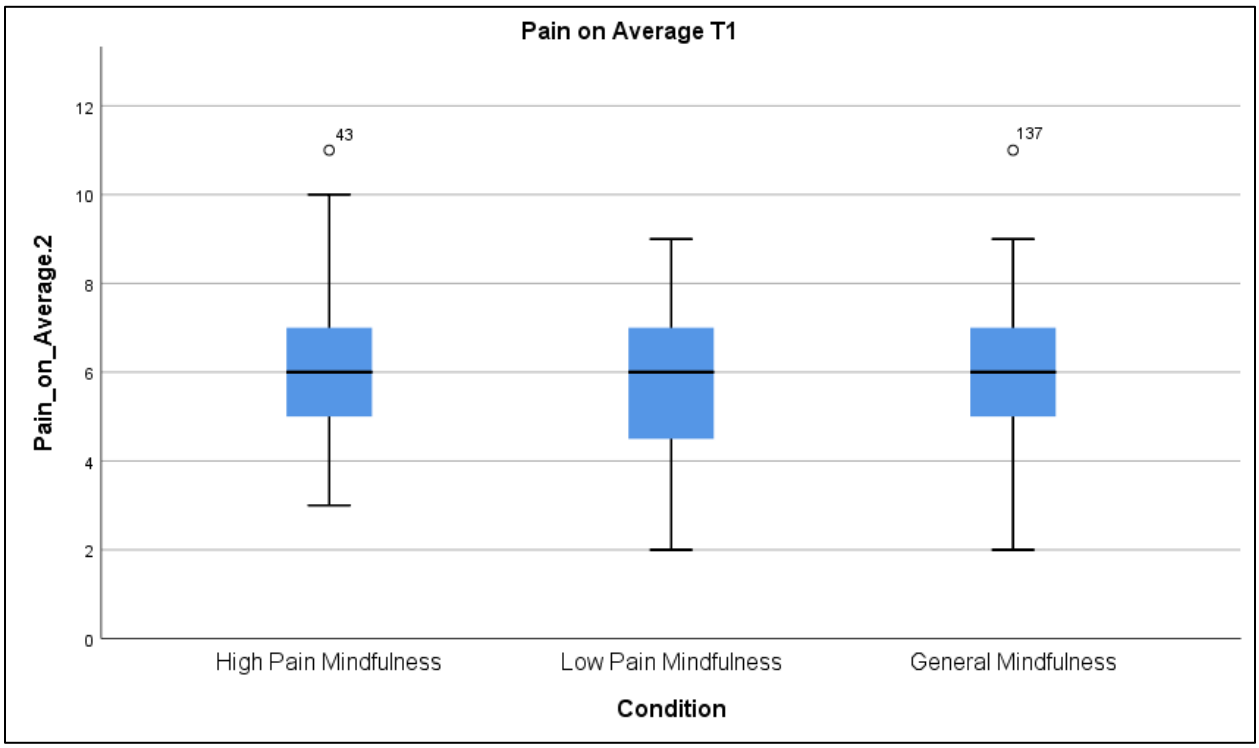


Figure 4.43. Boxplot of "Pain Right Now" scores at T0

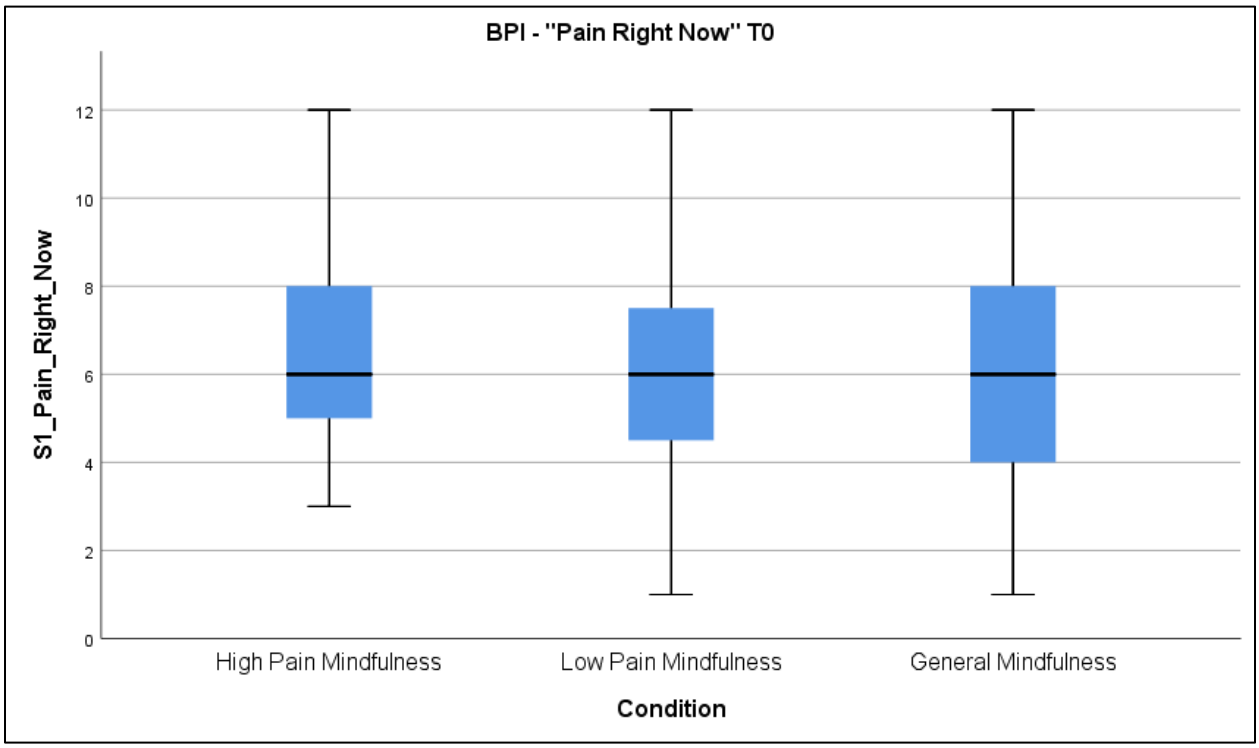


Figure 4.44. Boxplot of "Pain Right Now" scores at T1

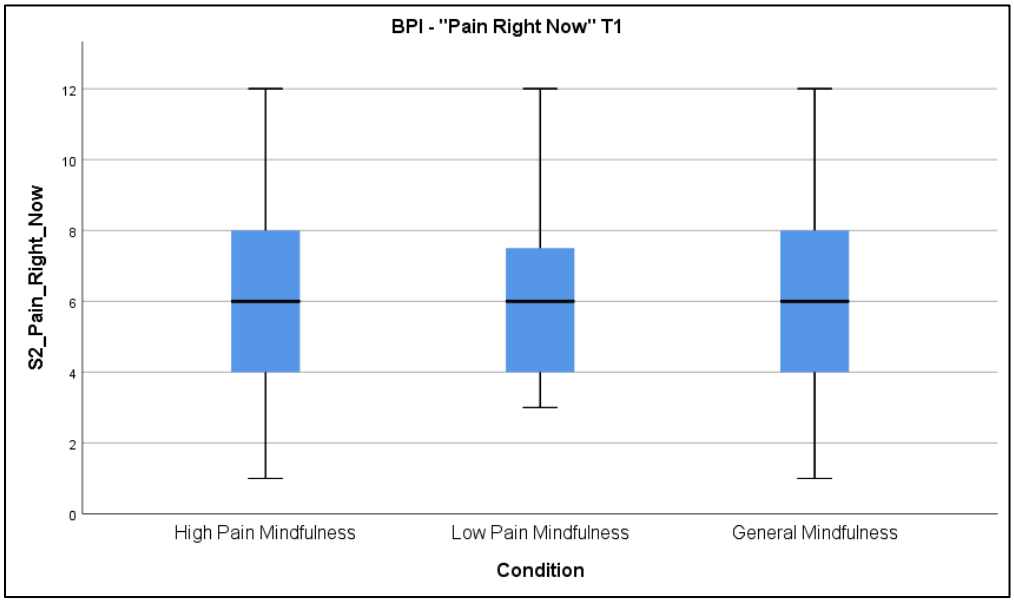


Figure 4.45. Boxplot of Pain Interference scores at T0

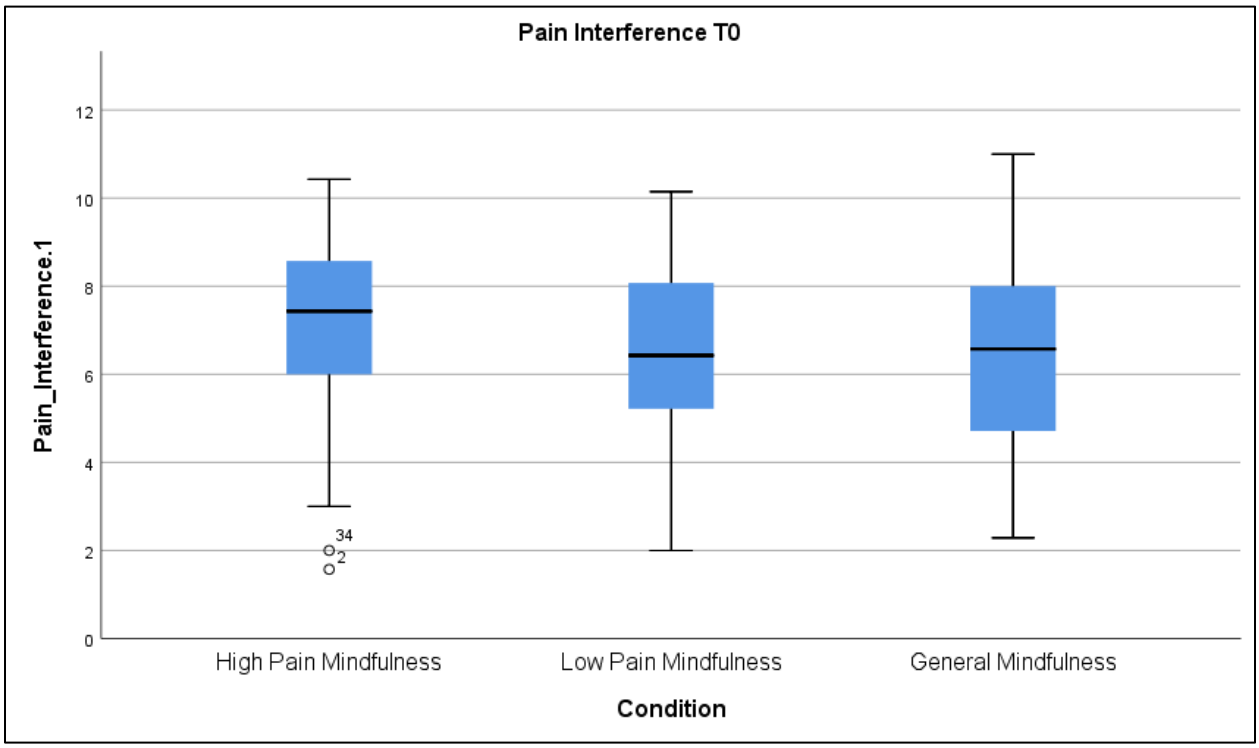


Figure 4.46. Boxplot of Pain Interference scores at T1

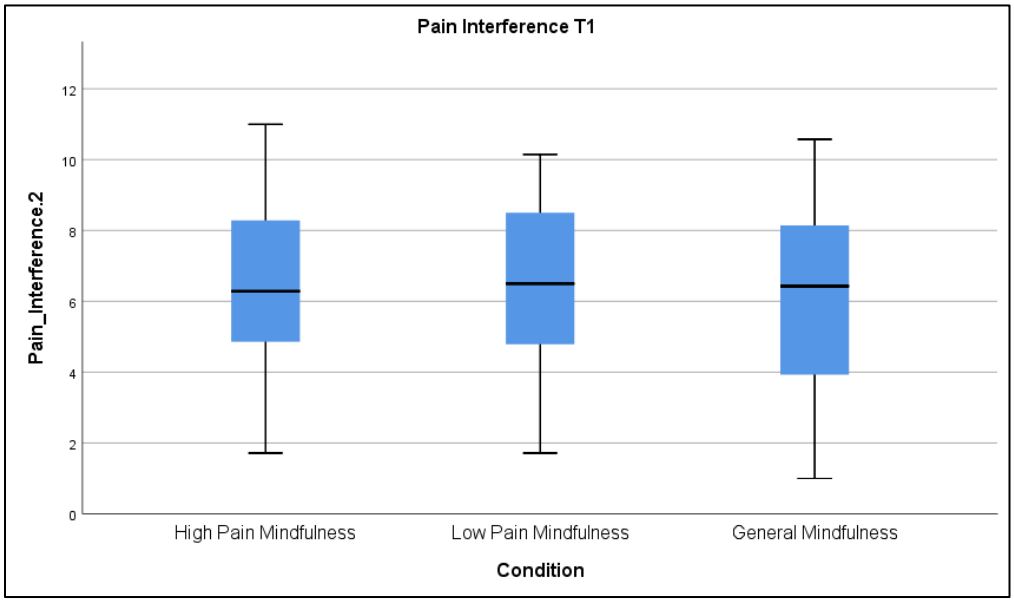


Figure 4.47. Boxplot of PCS – Rumination scores at T0

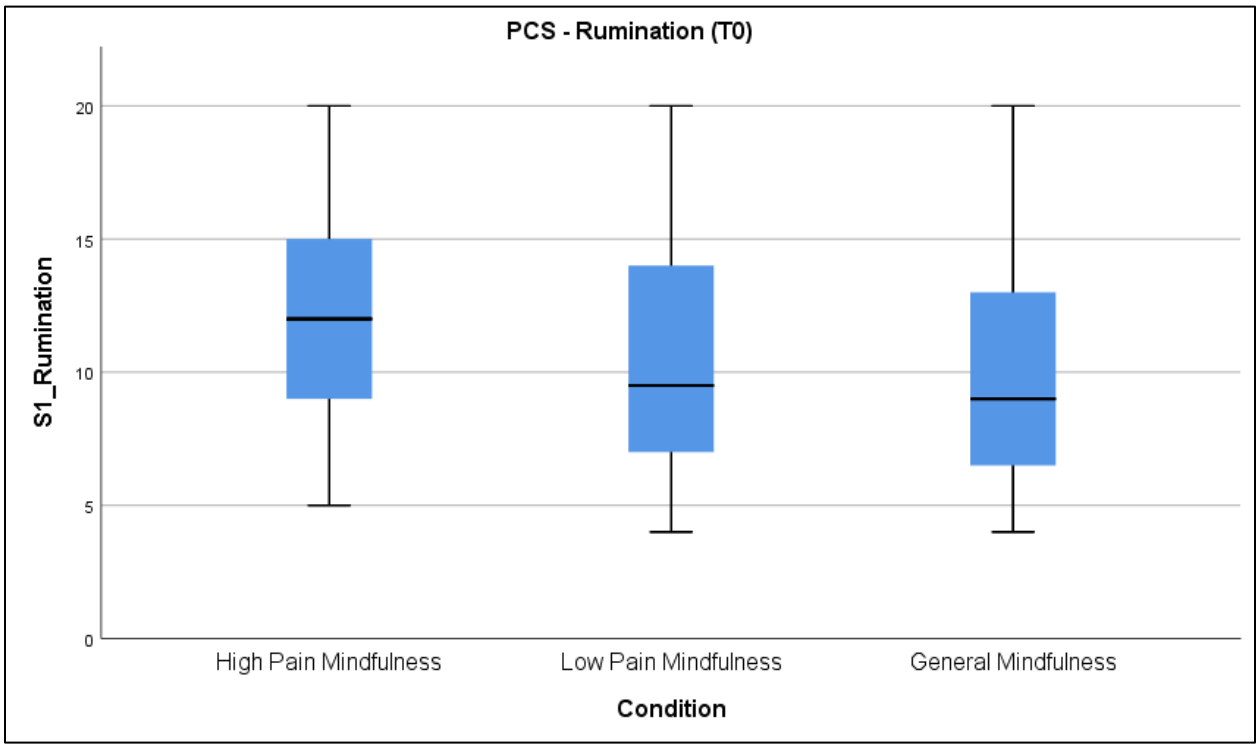


Figure 4.48. Boxplot of PCS – Rumination scores at T1

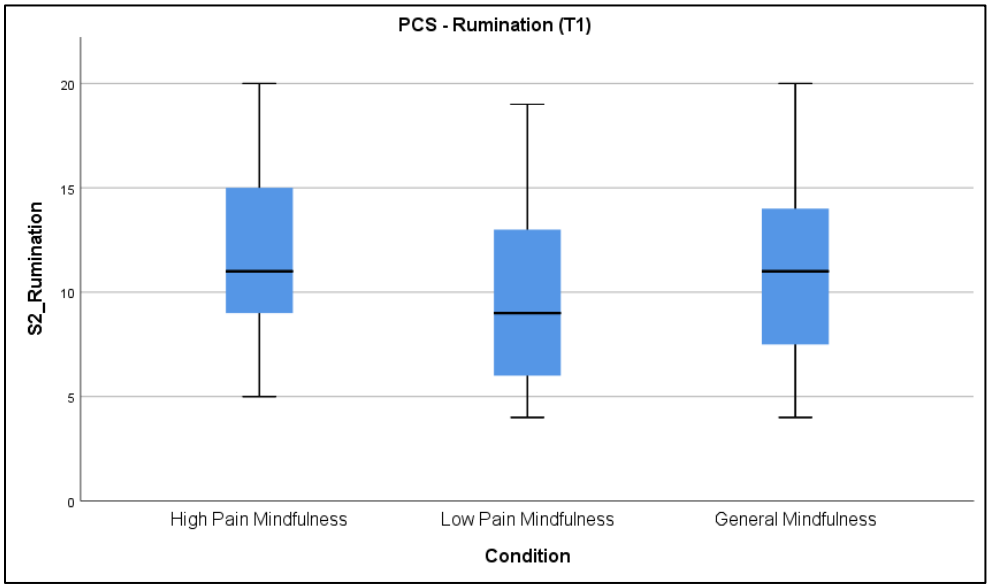


Figure 4.49. Boxplot of PCS – Magnification scores at T0

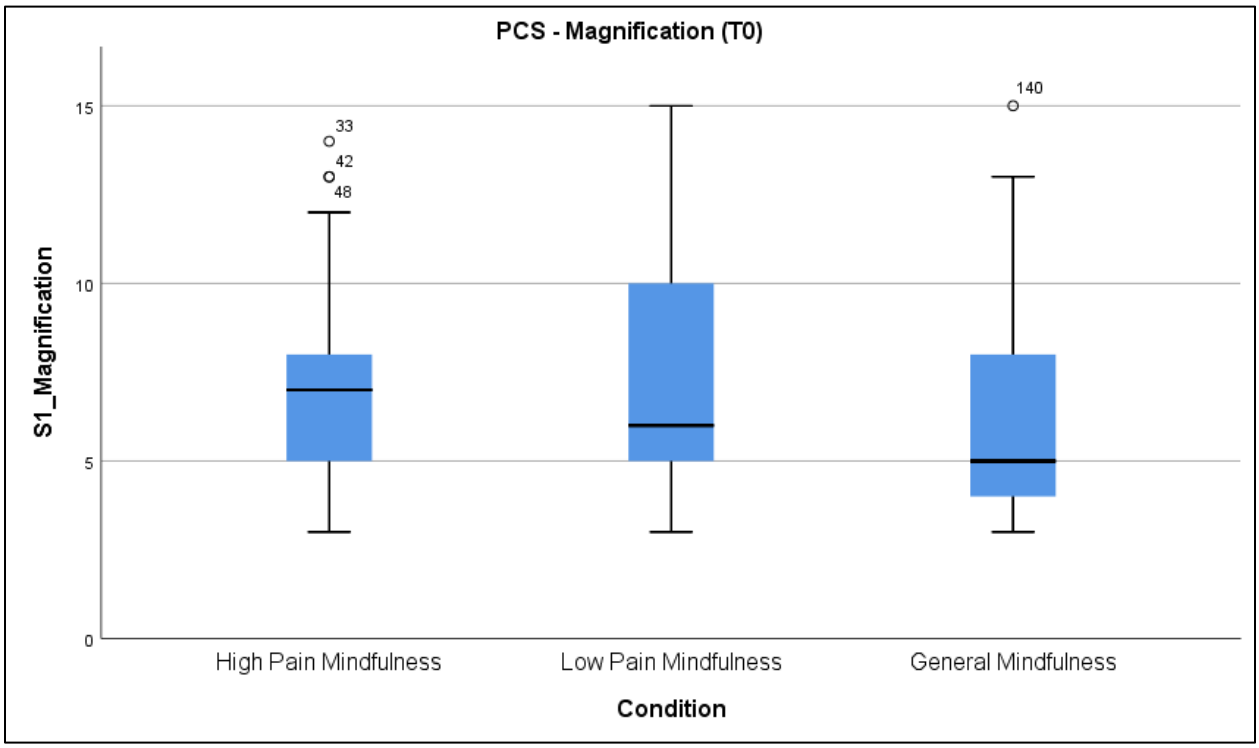


Figure 4.50. Boxplot of PCS – Magnification scores at T1

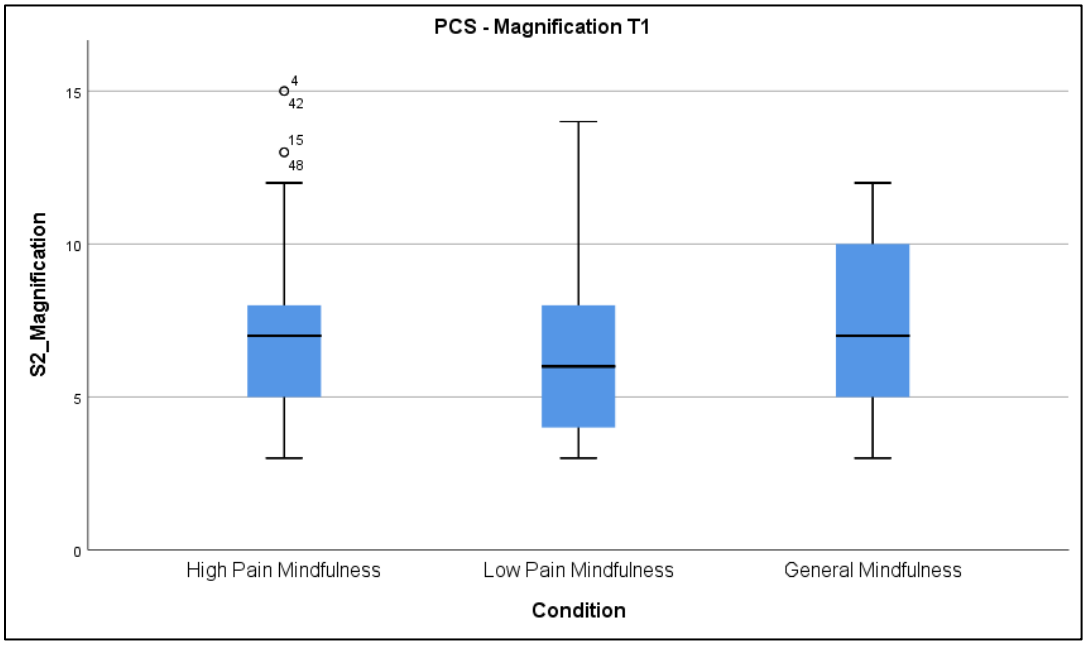


Figure 4.51. Boxplot of PCS – Helplessness scores at T0

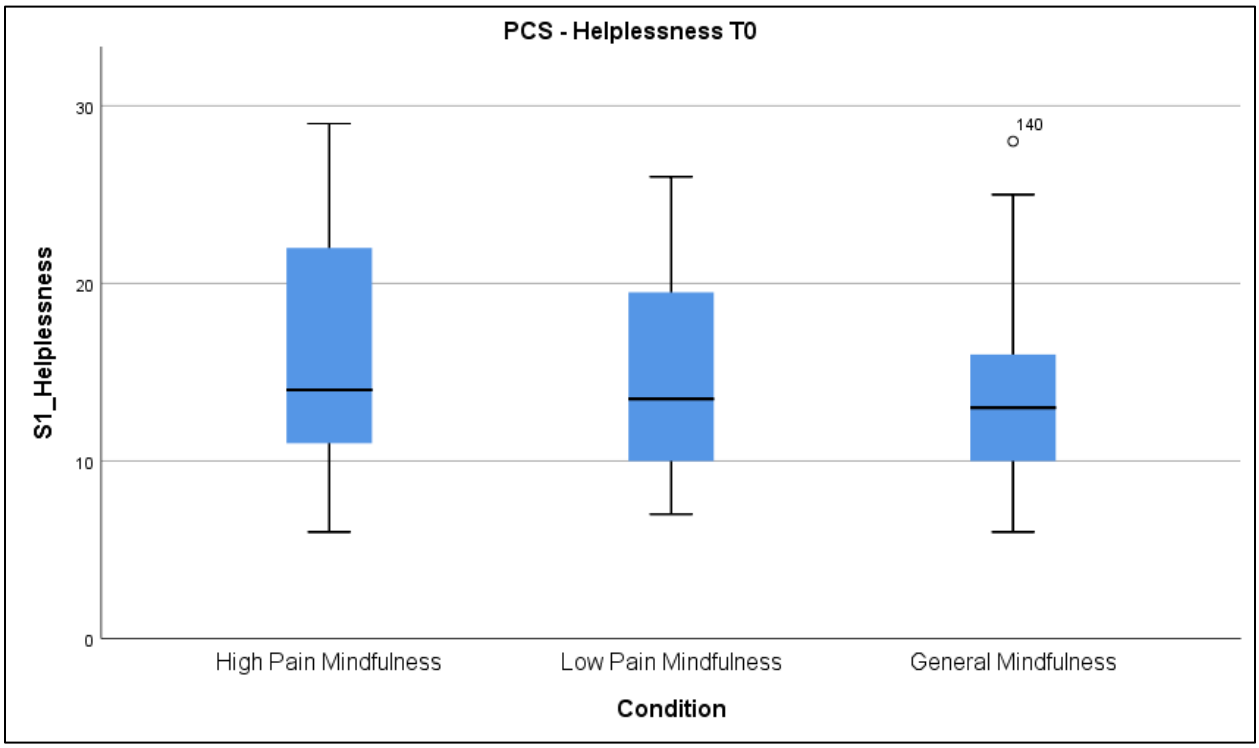


Figure 4.52. Boxplot of PCS – Helplessness scores at T1

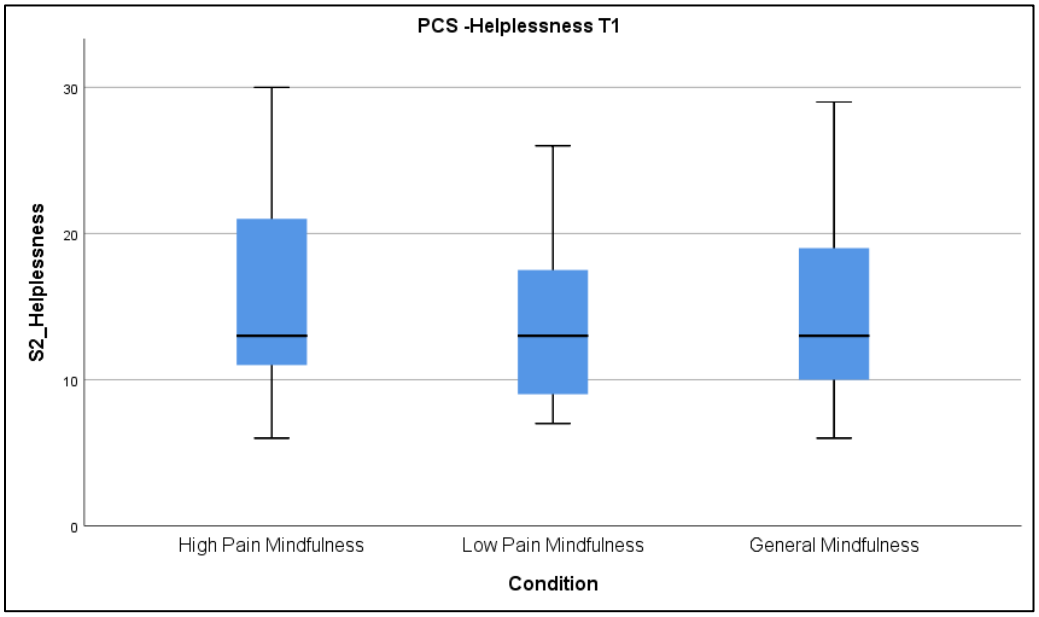


Figure 4.53. Descriptive Statistics of Participant Age across Experimental Conditions

Descriptives

Age

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
High Mindfulness	53	42.45	14.641	2.011	38.42	46.49	19	68
Low Mindfulness	48	46.27	16.790	2.423	41.40	51.15	19	79
Active Control	55	43.60	14.971	2.019	39.55	47.65	21	81
Total	156	44.03	15.426	1.235	41.59	46.47	19	81

Figure 4.54. Descriptive Statistics of Pain Duration (in months) across Experimental Conditions

Descriptives

Pain_Duration

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
High Pain Mindfulness	52	128.2692	98.75025	13.69420	100.7770	155.7615	7.00	624.00
Low Pain Mindfulness	47	89.2979	106.05329	15.46946	58.1595	120.4363	4.00	600.00
General Mindfulness	54	86.8889	101.63989	13.83144	59.1465	114.6312	5.00	600.00
Total	153	101.6928	103.17386	8.34111	85.2133	118.1723	4.00	624.00

Figure 4.55. Descriptive Statistics of Pain Severity across Experimental Conditions

Descriptives

S1_Pain_Severity

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
High Pain Mindfulness	53	7.43	1.681	.231	6.97	7.90	2	10
Low Pain Mindfulness	48	7.40	1.581	.228	6.94	7.85	4	11
General Mindfulness	55	7.13	1.915	.258	6.61	7.65	3	11
Total	156	7.31	1.733	.139	7.04	7.59	2	11

Figure 4.56. One-way ANOVA Comparing Age Across Experimental Condition

ANOVA

Age

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	383.029	2	191.514	.803	.450
Within Groups	36499.811	153	238.561		
Total	36882.840	155			

Figure 4.57. One-way ANOVA Comparing Pain Duration Across Experimental Condition

ANOVA

Pain_Duration

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	55783.168	2	27891.584	2.678	.072
Within Groups	1562233.394	150	10414.889		
Total	1618016.562	152			

Figure 4.58. One-way ANOVA Comparing Pain Severity Across Experimental Condition

ANOVA

S1_Pain_Severity

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.002	2	1.501	.496	.610
Within Groups	462.607	153	3.024		
Total	465.609	155			

Figure 4.59. Test of Equality of Means for MHLC - Doctors at T0

ANOVA

MHLC_Doctors.1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.732	2	1.866	.135	.874
Within Groups	2115.261	153	13.825		
Total	2118.994	155			

Figure 4.60. ANCOVA Results for MHLC- "Doctors"

Tests of Between-Subjects Effects

Dependent Variable: MHLC_Doctors.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	779.868[a]	3	259.956	38.110	.000	.429	114.331	1.000
Intercept	449.560	1	449.560	65.907	.000	.302	65.907	1.000
MHLC_Doctors.1	769.572	1	769.572	112.821	.000	.426	112.821	1.000
Condition	16.360	2	8.180	1.199	.304	.016	2.398	.259
Error	1036.818	152	6.821					
Total	22287.000	156						
Corrected Total	1816.686	155						

a. R Squared = .429 (Adjusted R Squared = .418)

b. Computed using alpha = .05

Figure 4.61. Estimated Marginal Means for MHLC- "Doctors" at T1

Estimates

Dependent Variable: MHLC_Doctors.2

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	11.863[a]	.359	11.154	12.572
Low Pain Mindfulness	11.429[a]	.377	10.684	12.174
General Mindfulness	11.085[a]	.352	10.389	11.781

a. Covariates appearing in the model are evaluated at the following values: MHLC_Doctors.1 = 10.49.

Figure 4.62. Test of Equality of Means for MHLC - Chance at T0

ANOVA

MHLC_Chance.1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	43.645	2	21.823	.527	.591
Within Groups	6336.528	153	41.415		
Total	6380.173	155			

Figure 4.63. ANCOVA Results for MHLC- "Chance"

Tests of Between-Subjects Effects

Dependent Variable: Chance_Reciprocal

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	.052[a]	3	.017	34.870	.000	.408	104.609	1.000
Intercept	.210	1	.210	423.210	.000	.736	423.210	1.000
MHLC_Chance.1	.050	1	.050	100.431	.000	.398	100.431	1.000
Condition	.001	2	.000	.733	.482	.010	1.465	.172
Error	.075	152	.000					
Total	.690	156						
Corrected Total	.127	155						

a. R Squared = .408 (Adjusted R Squared = .396)

b. Computed using alpha = .05

Figure 4.64. Estimated Marginal Means for MHLC- "Chance" at T1

Estimates

Dependent Variable: Chance_Reciprocal

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	.059[a]	.003	.053	.065
Low Pain Mindfulness	.063[a]	.003	.057	.070
General Mindfulness	.058[a]	.003	.052	.064

a. Covariates appearing in the model are evaluated at the following values: MHLC_Chance.1 = 18.37.

Figure 4.65. Test of Equality of Means for MHLC - Internal at T0

ANOVA

MHLC_Internal.1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.845	2	5.922	.138	.872
Within Groups	6588.841	153	43.064		
Total	6600.686	155			

Figure 4.66. ANCOVA Results for "MHLC" Internal

Tests of Between-Subjects Effects

Dependent Variable: MHLC_Internal.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	3410.611[a]	3	1136.870	57.252	.000	.531	171.755	1.000
Intercept	476.080	1	476.080	23.975	.000	.136	23.975	.998
MHLC_Internal.1	3394.288	1	3394.288	170.933	.000	.529	170.933	1.000
Condition	15.918	2	7.959	.401	.670	.005	.802	.114
Error	3018.332	152	19.857					
Total	54099.000	156						
Corrected Total	6428.942	155						

a. R Squared = .531 (Adjusted R Squared = .521)

b. Computed using alpha = .05

Figure 4.67. Estimated Marginal Means for MHLC- "Internal" at T1

Estimates

Dependent Variable: MHLC_Internal.2

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	17.568[a]	.612	16.358	18.778
Low Pain Mindfulness	17.023[a]	.643	15.752	18.294
General Mindfulness	17.796[a]	.601	16.608	18.984

a. Covariates appearing in the model are evaluated at the following values: MHLC_Internal.1 = 17.38.

Figure 4.68. Test of Equality of Means for PBAPI – "Pain as Permanent" at T0

ANOVA

Pain_As_Permanent.1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.263	2	.132	.158	.854
Within Groups	127.257	153	.832		
Total	127.520	155			

Figure 4.69. ANCOVA Results for PBAPI – "Pain as Permanent"

Tests of Between-Subjects Effects

Dependent Variable: Pain_As_Permanent.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	87.591[a]	3	29.197	91.352	.000	.643	274.057	1.000
Intercept	.119	1	.119	.373	.542	.002	.373	.093
Pain_As_Permanent.1	84.005	1	84.005	262.837	.000	.634	262.837	1.000
Condition	2.251	2	1.126	3.522	.032	.044	7.043	.649
Error	48.581	152	.320					
Total	219.236	156						
Corrected Total	136.172	155						

a. R Squared = .643 (Adjusted R Squared = .636)

b. Computed using alpha = .05

Figure 4.70. Estimated Marginal Means for PBAPI – "Pain as Permanent" at T1

Estimates

Dependent Variable: Pain_As_Permanent.2

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	.665[a]	.078	.512	.819
Low Pain Mindfulness	.909[a]	.082	.748	1.070
General Mindfulness	.635[a]	.076	.485	.786

a. Covariates appearing in the model are evaluated at the following values: Pain_As_Permanent.1 = .9562.

Figure 4.71. Pairwise Comparisons for Estimated Marginal Means of PBAPI "Pain as Permanent"

Pairwise Comparisons

Dependent Variable: Pain_As_Permanent.2

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
High Pain Mindfulness	Low Pain Mindfulness	-.244	.113	.096	-.517	.029
	General Mindfulness	.030	.109	1.000	-.233	.294
Low Pain Mindfulness	High Pain Mindfulness	.244	.113	.096	-.029	.517
	General Mindfulness	.274*	.112	.046	.003	.544
General Mindfulness	High Pain Mindfulness	-.030	.109	1.000	-.294	.233
	Low Pain Mindfulness	-.274*	.112	.046	-.544	-.003

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Figure 4.72. Test of Equality of Means for PBAPI – "Pain as Mystery" at T0

ANOVA

Pain_As_Mystery.1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.141	2	.070	.057	.945
Within Groups	189.748	153	1.240		
Total	189.889	155			

Figure 4.73. ANCOVA Results for PBAPI – "Pain as Mystery"

Tests of Between-Subjects Effects

Dependent Variable: Pain_Mystery_Reciprocal

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	30.378[a]	3	10.126	5.614	.001	.111	16.841	.939
Intercept	8.866	1	8.866	4.915	.028	.035	4.915	.595
Pain_As_Mystery.1	29.182	1	29.182	16.178	.000	.107	16.178	.979
Condition	.762	2	.381	.211	.810	.003	.423	.082
Error	243.514	135	1.804					
Total	285.464	139						
Corrected Total	273.893	138						

a. R Squared = .111 (Adjusted R Squared = .091)

b. Computed using alpha = .05

Figure 4.74. Estimated Marginal Means for PBAPI – "Pain as Mystery" at T1

Estimates

Dependent Variable: Pain_Mystery_Reciprocal

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	-.395[a]	.203	-.796	.005
Low Pain Mindfulness	-.257[a]	.198	-.648	.135
General Mindfulness	-.222[a]	.192	-.602	.157

a. Covariates appearing in the model are evaluated at the following values: Pain_As_Mystery.1 = -.0935.

Figure 4.75. Test of Equality of Means for PBAPI – "Pain as Constant" at T0

ANOVA

Pain_As_Constant.1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.049	2	.024	.057	.945
Within Groups	65.423	153	.428		
Total	65.472	155			

Figure 4.76. ANCOVA Results for PBAPI – "Pain as Constant"

Tests of Between-Subjects Effects

Dependent Variable: Pain_As_Constant.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	33.528[a]	3	11.176	50.269	.000	.498	150.806	1.000
Intercept	.500	1	.500	2.247	.136	.015	2.247	.319
Pain_As_Constant.1	33.375	1	33.375	150.118	.000	.497	150.118	1.000
Condition	.084	2	.042	.188	.829	.002	.376	.079
Error	33.794	152	.222					
Total	81.083	156						
Corrected Total	67.322	155						

a. R Squared = .498 (Adjusted R Squared = .488)

b. Computed using alpha = .05

Figure 4.77. Estimated Marginal Means for PBAPI – "Pain as Constant" at T1

Estimates

Dependent Variable: Pain_As_Constant.2

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	.270[a]	.065	.142	.398
Low Pain Mindfulness	.293[a]	.068	.159	.428
General Mindfulness	.326[a]	.064	.200	.451

a. Covariates appearing in the model are evaluated at the following values: Pain_As_Constant.1 = .3264.

Figure 4.78. Test of Equality of Means for PBAPI – "Self-Blame" at T0

ANOVA

SelfBlame.1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.567	2	.783	1.124	.327
Within Groups	106.603	153	.697		
Total	108.170	155			

Figure 4.79. ANCOVA Results for PBAPI – "Self-Blame"

Tests of Between-Subjects Effects

Dependent Variable: SelfBlame.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	55.922[a]	3	18.641	65.474	.000	.564	196.422	1.000
Intercept	3.962	1	3.962	13.915	.000	.084	13.915	.960
SelfBlame.1	55.879	1	55.879	196.272	.000	.564	196.272	1.000
Condition	.962	2	.481	1.689	.188	.022	3.379	.351
Error	43.275	152	.285					
Total	238.188	156						
Corrected Total	99.197	155						

a. R Squared = .564 (Adjusted R Squared = .555)

b. Computed using alpha = .05

Figure 4.80. Estimated Marginal Means for PBAPI – "Self-Blame" at T1

Estimates

Dependent Variable: SelfBlame.2

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	-1.008[a]	.073	-1.153	-.863
Low Pain Mindfulness	-.995[a]	.077	-1.148	-.843
General Mindfulness	-.837[a]	.072	-.980	-.694

a. Covariates appearing in the model are evaluated at the following values: SelfBlame.1 = -.9690.

Figure 4.81. Test of Equality of Means for Pain Interference at T0

ANOVA

Pain_Interference.1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13.792	2	6.896	1.445	.239
Within Groups	730.297	153	4.773		
Total	744.088	155			

Figure 4.82. Test of Equality of Means for Pain Interference at T1

ANOVA

Pain_Interference.2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.460	2	1.730	.276	.759
Within Groups	957.280	153	6.257		
Total	960.739	155			

Figure 4.83. Test of Equality of Means for BPI - "Pain on Average" at T0

ANOVA

Pain_on_Average.1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.988	2	.994	.258	.773
Within Groups	589.909	153	3.856		
Total	591.897	155			

Figure 4.84. ANCOVA Results for BPI – "Pain on Average"

Tests of Between-Subjects Effects

Dependent Variable: Pain_on_Average.2

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	118.521[a]	3	39.507	16.604	.000	.247	49.813	1.000
Intercept	275.095	1	275.095	115.620	.000	.432	115.620	1.000
Pain_on_Average.1	117.202	1	117.202	49.259	.000	.245	49.259	1.000
Condition	1.250	2	.625	.263	.769	.003	.526	.091
Error	361.652	152	2.379					
Total	5847.000	156						
Corrected Total	480.173	155						

a. R Squared = .247 (Adjusted R Squared = .232)

b. Computed using alpha = .05

Figure 4.85. Estimated Marginal Means for BPI – "Pain on Average" at T1

Estimates

Dependent Variable: Pain_on_Average.2

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	5.982[a]	.212	5.564	6.401
Low Pain Mindfulness	5.764[a]	.223	5.324	6.204
General Mindfulness	5.841[a]	.208	5.430	6.252

a. Covariates appearing in the model are evaluated at the following values: Pain_on_Average.1 = 4.97.

Figure 4.86. Test of Equality of Means for BPI - "Pain Right Now" at T0

ANOVA

S1_Pain_Right_Now

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.317	2	6.158	1.220	.298
Within Groups	772.273	153	5.048		
Total	784.590	155			

Figure 4.87. ANCOVA Results for BPI – "Pain Right Now"

Tests of Between-Subjects Effects

Dependent Variable: S2_Pain_Right_Now

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	136.667[a]	3	45.556	7.975	.000	.136	23.924	.989
Intercept	259.513	1	259.513	45.428	.000	.230	45.428	1.000
S1_Pain_Right_Now	124.761	1	124.761	21.839	.000	.126	21.839	.996
Condition	7.415	2	3.708	.649	.524	.008	1.298	.157
Error	868.326	152	5.713					
Total	7275.000	156						
Corrected Total	1004.994	155						

a. R Squared = .136 (Adjusted R Squared = .119)

b. Computed using alpha = .05

Figure 4.88. Estimated Marginal Means for BPI – "Pain Right Now" at T1

Estimates

Dependent Variable: S2_Pain_Right_Now

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	6.486[a]	.330	5.834	7.138
Low Pain Mindfulness	6.012[a]	.345	5.330	6.694
General Mindfulness	6.484[a]	.323	5.846	7.122

a. Covariates appearing in the model are evaluated at the following values: S1_Pain_Right_Now = 6.22.

Figure 4.89. Test of Equality of Means for PCS - "Magnification" at T0

ANOVA

S1_Magnification

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	22.143	2	11.072	1.277	.282
Within Groups	1326.934	153	8.673		
Total	1349.077	155			

Figure 4.90. ANCOVA Results for PCS – "Magnification"

Tests of Between-Subjects Effects

Dependent Variable: S2_Magnification

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	692.687[a]	3	230.896	64.485	.000	.560	193.454	1.000
Intercept	94.720	1	94.720	26.453	.000	.148	26.453	.999
S1_Magnification	677.024	1	677.024	189.080	.000	.554	189.080	1.000
Condition	29.656	2	14.828	4.141	.018	.052	8.282	.724
Error	544.255	152	3.581					
Total	8839.000	156						
Corrected Total	1236.942	155						

a. R Squared = .560 (Adjusted R Squared = .551)

b. Computed using alpha = .05

Figure 4.91. Estimated Marginal Means for BPI – "Magnification" at T1

Estimates

Dependent Variable: S2_Magnification

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	7.039[a]	.261	6.525	7.554
Low Pain Mindfulness	6.377[a]	.273	5.837	6.917
General Mindfulness	7.452[a]	.256	6.945	7.958

a. Covariates appearing in the model are evaluated at the following values: S1_Magnification = 6.92.

Figure 4.92. Pairwise Comparisons for Estimated Marginal Means of PCS – "Magnification"

Pairwise Comparisons

Dependent Variable: S2_Magnification

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
High Pain Mindfulness	Low Pain Mindfulness	.663	.377	.242	-.250	1.576
	General Mindfulness	-.412	.367	.789	-1.300	.476
Low Pain Mindfulness	High Pain Mindfulness	-.663	.377	.242	-1.576	.250
	General Mindfulness	-1.075*	.376	.014	-1.984	-.166
General Mindfulness	High Pain Mindfulness	.412	.367	.789	-.476	1.300
	Low Pain Mindfulness	1.075*	.376	.014	.166	1.984

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Figure 4.93. Test of Equality of Means for PCS - "Rumination" at T0

ANOVA

S1_Rumination

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	93.385	2	46.692	2.584	.079
Within Groups	2764.923	153	18.071		
Total	2858.308	155			

Figure 4.94. ANCOVA Results for PCS – "Rumination"

Tests of Between-Subjects Effects

Dependent Variable: S2_Rumination

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	1540.828[a]	3	513.609	60.542	.000	.544	181.625	1.000
Intercept	187.874	1	187.874	22.146	.000	.127	22.146	.997
S1_Rumination	1416.930	1	1416.930	167.021	.000	.524	167.021	1.000
Condition	47.735	2	23.867	2.813	.063	.036	5.627	.546
Error	1289.499	152	8.484					
Total	21117.000	156						
Corrected Total	2830.327	155						

a. R Squared = .544 (Adjusted R Squared = .535)

b. Computed using alpha = .05

Figure 4.95. Estimated Marginal Means for BPI – "Rumination" at T1

Estimates

Dependent Variable: S2_Rumination

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	11.039[a]	.405	10.240	11.839
Low Pain Mindfulness	10.016[a]	.422	9.183	10.849
General Mindfulness	11.330[a]	.394	10.552	12.108

a. Covariates appearing in the model are evaluated at the following values: S1_Rumination = 10.85.

Figure 4.96. Test of Equality of Means for PCS - "Helplessness" at T0

ANOVA

S1_Helplessness

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	118.327	2	59.164	1.822	.165
Within Groups	4968.667	153	32.475		
Total	5086.994	155			

Figure 4.97. ANCOVA Results for PCS – "Helplessness"

Tests of Between-Subjects Effects

Dependent Variable: S2_Helplessness

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	2314.351[a]	3	771.450	42.886	.000	.458	128.658	1.000
Intercept	393.018	1	393.018	21.848	.000	.126	21.848	.996
S1_Helplessness	2285.298	1	2285.298	127.043	.000	.455	127.043	1.000
Condition	22.086	2	11.043	.614	.543	.008	1.228	.151
Error	2734.239	152	17.988					
Total	38080.000	156						
Corrected Total	5048.590	155						

a. R Squared = .458 (Adjusted R Squared = .448)

b. Computed using alpha = .05

Figure 4.98. Estimated Marginal Means PCS – "Helplessness" at T1

Estimates

Dependent Variable: S2_Helplessness

Condition	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
High Pain Mindfulness	14.384[a]	.586	13.225	15.542
Low Pain Mindfulness	14.165[a]	.612	12.956	15.375
General Mindfulness	15.050[a]	.575	13.914	16.186

a. Covariates appearing in the model are evaluated at the following values: S1_Helplessness = 14.84.

Figure 4.99. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on BPI- "Pain on Average"

LMS_Split_25 * Pain_Average_String Crosstabulation

Count

		Pain_Average_String		
		-1.00	1.00	Total
LMS_Split_25	Bottom 25%	8a	28a	36
	Top 25%	9a	20a	29
Total		17	48	65

Each subscript letter denotes a subset of Pain_Average_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.646[a]	1	.422		
Continuity Correction[b]	.270	1	.603		
Likelihood Ratio	.643	1	.423		
Fisher's Exact Test				.571	.301
Linear-by-Linear Association	.636	1	.425		
N of Valid Cases	65				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.58.

b. Computed only for a 2x2 table

Figure 4.100. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on BPI- "Pain Right Now"

LMS_Split_25 * Pain_Right_Now_Change_String Crosstabulation

Count

		Pain_Right_Now_Change_String		
		-1.00	Increased	Total
LMS_Split_25	Bottom 25%	14a	15a	29
	Top 25%	18a	13a	31
Total		32	28	60

Each subscript letter denotes a subset of Pain_Right_Now_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.577[a]	1	.448		
Continuity Correction[b]	.251	1	.617		
Likelihood Ratio	.578	1	.447		
Fisher's Exact Test				.605	.309
Linear-by-Linear Association	.567	1	.451		
N of Valid Cases	60				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.53.

b. Computed only for a 2x2 table

Figure 4.101. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on Pain Interference

LMS_Split_25 * Interference_Change_String Crosstabulation

Count

		Interference_Change_String		
		Decreased	Increased	Total
LMS_Split_25	Bottom 25%	17a	14a	31
	Top 25%	19a	12a	31
Total		36	26	62

Each subscript letter denotes a subset of Interference_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.265[a]	1	.607		
Continuity Correction[b]	.066	1	.797		
Likelihood Ratio	.265	1	.607		
Fisher's Exact Test				.797	.399
Linear-by-Linear Association	.261	1	.610		
N of Valid Cases	62				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.00.

b. Computed only for a 2x2 table

Figure 4.102. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on PCS-Rumination

LMS_Split_25 * Rumination_Change_String Crosstabulation

Count

		Rumination_Change_String		
		Decreased	Increased	Total
LMS_Split_25	Bottom 25%	14a	16a	30
	Top 25%	20a	13a	33
Total		34	29	63

Each subscript letter denotes a subset of Rumination_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.229[a]	1	.268		
Continuity Correction[b]	.732	1	.392		
Likelihood Ratio	1.232	1	.267		
Fisher's Exact Test				.317	.196
Linear-by-Linear Association	1.210	1	.271		
N of Valid Cases	63				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.81.

b. Computed only for a 2x2 table

Figure 4.103. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on PCS-Magnification

LMS_Split_25 * Magnification_Change_String Crosstabulation

Count

		Magnification_Change_String		
		Decreased	Increased	Total
LMS_Split_25	Bottom 25%	15a	16a	31
	Top 25%	14a	15a	29
Total		29	31	60

Each subscript letter denotes a subset of Magnification_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.000[a]	1	.993		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.000	1	.993		
Fisher's Exact Test				1.000	.599
Linear-by-Linear Association	.000	1	.993		
N of Valid Cases	60				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.02.

b. Computed only for a 2x2 table

Figure 4.104. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on PCS-Helplessness

LMS_Split_25 * Helplessness_Change_String Crosstabulation

Count

		Helplessness_Change_String		
		Decreased	Increased	Total
LMS_Split_25	Bottom 25%	17a	19a	36
	Top 25%	21a	9a	30
Total		38	28	66

Each subscript letter denotes a subset of Helplessness_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.476[a]	1	.062		
Continuity Correction[b]	2.606	1	.106		
Likelihood Ratio	3.527	1	.060		
Fisher's Exact Test				.082	.053
Linear-by-Linear Association	3.423	1	.064		
N of Valid Cases	66				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.73.

b. Computed only for a 2x2 table

Figure 4.105. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on MHLC-Internal

LMS_Split_25 * MHLC_Internal_Change_String Crosstabulation

Count

		MHLC_Internal_Change_String		
		Decreased	Increased	Total
LMS_Split_25	Bottom 25%	19a	17a	36
	Top 25%	21a	17a	38
Total		40	34	74

Each subscript letter denotes a subset of MHLC_Internal_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.046[a]	1	.830		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.046	1	.830		
Fisher's Exact Test				1.000	.507
Linear-by-Linear Association	.045	1	.831		
N of Valid Cases	74				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 16.54.

b. Computed only for a 2x2 table

Figure 4.106. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on MHLC-Chance

LMS_Split_25 * MHLC_Chance_Change_String Crosstabulation

Count

		MHLC_Chance_Change_String		
		Decreased	Increased	Total
LMS_Split_25	Bottom 25%	16a	25a	41
	Top 25%	13a	22a	35
Total		29	47	76

Each subscript letter denotes a subset of MHLC_Chance_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.028[a]	1	.866		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.028	1	.866		
Fisher's Exact Test				1.000	.528
Linear-by-Linear Association	.028	1	.867		
N of Valid Cases	76				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.36.

b. Computed only for a 2x2 table

Figure 4.107. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on MHLC-Doctors

LMS_Split_25 * MHLC_Doctors_Change_String Crosstabulation

Count

		MHLC_Doctors_Change_String		
		Decreased	Increased	Total
LMS_Split_25	Bottom 25%	10a	24a	34
	Top 25%	13a	20a	33
Total		23	44	67

Each subscript letter denotes a subset of MHLC_Doctors_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.740[a]	1	.390		
Continuity Correction[b]	.364	1	.547		
Likelihood Ratio	.742	1	.389		
Fisher's Exact Test				.447	.273
Linear-by-Linear Association	.729	1	.393		
N of Valid Cases	67				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.33.

b. Computed only for a 2x2 table

Figure 4.108. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on PBAPI-"Pain as Mystery"

LMS_Split_25 * Pain_Mystery_Change_String Crosstabulation

Count

		Pain_Mystery_Change_String		
		Decrease	Increase	Total
LMS_Split_25	Bottom 25%	20a	10a	30
	Top 25%	24a	10a	34
Total		44	20	64

Each subscript letter denotes a subset of Pain_Mystery_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.114[a]	1	.736		
Continuity Correction[b]	.005	1	.946		
Likelihood Ratio	.114	1	.736		
Fisher's Exact Test				.791	.472
Linear-by-Linear Association	.112	1	.738		
N of Valid Cases	64				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.38.

b. Computed only for a 2x2 table

Figure 4.109. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on PBAPI-"Pain as Constant"

LMS_Split_25 * Pain_Constant_Change_String Crosstabulation

Count

		Pain_Constant_Change_String		
		Decreased	Increased	Total
LMS_Split_25	Bottom 25%	14a	12a	26
	Top 25%	12a	15a	27
Total		26	27	53

Each subscript letter denotes a subset of Pain_Constant_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.468[a]	1	.494		
Continuity Correction[b]	.168	1	.682		
Likelihood Ratio	.469	1	.493		
Fisher's Exact Test				.587	.341
Linear-by-Linear Association	.460	1	.498		
N of Valid Cases	53				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.75.

b. Computed only for a 2x2 table

Figure 4.110. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on PBAPI-"Pain as Permanent"

LMS_Split_25 * Pain_Perm_Change_String Crosstabulation

Count

		Pain_Perm_Change_String		
		Decreased	Increased	Total
LMS_Split_25	Bottom 25%	20a	8a	28
	Top 25%	19a	9a	28
Total		39	17	56

Each subscript letter denotes a subset of Pain_Perm_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.084[a]	1	.771		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.085	1	.771		
Fisher's Exact Test				1.000	.500
Linear-by-Linear Association	.083	1	.773		
N of Valid Cases	56				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.50.

b. Computed only for a 2x2 table

Figure 4.111. Chi-square test for effect of LMS Quartile (Top and Bottom 25%) on PBAPI-"Self-Blame"

LMS_Split_25 * SelfBlame_Change_String Crosstabulation

Count

		SelfBlame_Change_String		
		Decreased	Increased	Total
LMS_Split_25	Bottom 25%	10a	17a	27
	Top 25%	13a	15a	28
Total		23	32	55

Each subscript letter denotes a subset of SelfBlame_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.498[a]	1	.480		
Continuity Correction[b]	.187	1	.665		
Likelihood Ratio	.499	1	.480		
Fisher's Exact Test				.587	.333
Linear-by-Linear Association	.489	1	.484		
N of Valid Cases	55				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.29.

b. Computed only for a 2x2 table

Figure 4.112. Chi-square test for effect of "Pain as Constant" (Top and Bottom 25%) on BPI-"Pain on Average"

Pain_Constant_Change_String * Pain_Average_String Crosstabulation

Count

		Pain_Average_String		
		-1.00	1.00	Total
Pain_Constant_Change_String	Decreased	14a	27a	41
	Increased	13a	34a	47
Total		27	61	88

Each subscript letter denotes a subset of Pain_Average_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.433[a]	1	.510		
Continuity Correction[b]	.182	1	.670		
Likelihood Ratio	.433	1	.511		
Fisher's Exact Test				.644	.334
Linear-by-Linear Association	.428	1	.513		
N of Valid Cases	88				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.58.

b. Computed only for a 2x2 table

Figure 4.113. Chi-square test for effect of "Pain as Constant" (Top and Bottom 25%) on BPI-"Pain Right Now"

Pain_Constant_Change_String * Pain_Right_Now_Change_String Crosstabulation

Count

		Pain_Right_Now_Change_String		
		Decreased	Increased	Total
Pain_Constant_Change_String	Decreased	24a	18a	42
	Increased	16a	26a	42
Total		40	44	84

Each subscript letter denotes a subset of Pain_Right_Now_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.055[a]	1	.081		
Continuity Correction[b]	2.339	1	.126		
Likelihood Ratio	3.074	1	.080		
Fisher's Exact Test				.126	.063
Linear-by-Linear Association	3.018	1	.082		
N of Valid Cases	84				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 20.00.

b. Computed only for a 2x2 table

Figure 4.114. Chi-square test for effect of "Pain as Constant" (Top and Bottom 25%) on Pain Interference

Pain_Constant_Change_String * Interference_Change_String Crosstabulation

Count

		Interference_Change_String		
		Decreased	Increased	Total
Pain_Constant_Change_String	Decreased	23a	13a	36
	Increased	27a	17a	44
Total		50	30	80

Each subscript letter denotes a subset of Interference_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.054[a]	1	.816		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.054	1	.816		
Fisher's Exact Test				1.000	.501
Linear-by-Linear Association	.053	1	.818		
N of Valid Cases	80				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.50.

b. Computed only for a 2x2 table

Figure 4.115. Chi-square test for effect of "Pain as Constant" (Top and Bottom 25%) on PCS-Rumination

Pain_Constant_Change_String * Rumination_Change_String Crosstabulation

Count

		Rumination_Change_String		
		Decreased	Increased	Total
Pain_Constant_Change_String	Decreased	24a	19a	43
	Increased	20a	14a	34
Total		44	33	77

Each subscript letter denotes a subset of Rumination_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.070[a]	1	.791		
Continuity Correction[b]	.001	1	.974		
Likelihood Ratio	.070	1	.791		
Fisher's Exact Test				.820	.487
Linear-by-Linear Association	.069	1	.792		
N of Valid Cases	77				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.57.

b. Computed only for a 2x2 table

Figure 4.116. Chi-square test for effect of "Pain as Constant" (Top and Bottom 25%) on PCS-Magnification

Pain_Constant_Change_String * Magnification_Change_String Crosstabulation

Count

		Magnification_Change_String		
		Decreased	Increased	Total
Pain_Constant_Change_String	Decreased	17a	23a	40
	Increased	20a	19a	39
Total		37	42	79

Each subscript letter denotes a subset of Magnification_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.612[a]	1	.434		
Continuity Correction[b]	.310	1	.578		
Likelihood Ratio	.612	1	.434		
Fisher's Exact Test				.502	.289
Linear-by-Linear Association	.604	1	.437		
N of Valid Cases	79				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 18.27.

b. Computed only for a 2x2 table

Figure 4.117. Chi-square test for effect of "Pain as Constant" (Top and Bottom 25%) on PCS-Helplessness

Pain_Constant_Change_String * Helplessness_Change_String Crosstabulation

Count

		Helplessness_Change_String		
		Decreased	Increased	Total
Pain_Constant_Change_String	Decreased	25a	22a	47
	Increased	24a	19a	43
Total		49	41	90

Each subscript letter denotes a subset of Helplessness_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.062[a]	1	.803		
Continuity Correction[b]	.001	1	.970		
Likelihood Ratio	.062	1	.803		
Fisher's Exact Test				.835	.485
Linear-by-Linear Association	.062	1	.804		
N of Valid Cases	90				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 19.59.

b. Computed only for a 2x2 table

Figure 4.118. Chi-square test for effect of "Pain as Constant" (Top and Bottom 25%) on MHLC-Internal

Pain_Constant_Change_String * MHLC_Internal_Change_String Crosstabulation

Count

		MHLC_Internal_Change_String		
		Decreased	Increased	Total
Pain_Constant_Change_String	Decreased	27a	19b	46
	Increased	19a	33b	52
Total		46	52	98

Each subscript letter denotes a subset of MHLC_Internal_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.811[a]	1	.028		
Continuity Correction[b]	3.963	1	.047		
Likelihood Ratio	4.847	1	.028		
Fisher's Exact Test				.042	.023
Linear-by-Linear Association	4.762	1	.029		
N of Valid Cases	98				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 21.59.

b. Computed only for a 2x2 table

Figure 4.119. Chi-square test for effect of "Pain as Constant" (Top and Bottom 25%) on MHLC-Chance

Pain_Constant_Change_String * MHLC_Chance_Change_String Crosstabulation

Count

		MHLC_Chance_Change_String		
		Decreased	Increased	Total
Pain_Constant_Change_String	Decreased	20a	32a	52
	Increased	22a	27a	49
Total		42	59	101

Each subscript letter denotes a subset of MHLC_Chance_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.430[a]	1	.512		
Continuity Correction[b]	.206	1	.650		
Likelihood Ratio	.430	1	.512		
Fisher's Exact Test				.549	.325
Linear-by-Linear Association	.426	1	.514		
N of Valid Cases	101				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 20.38.

b. Computed only for a 2x2 table

Figure 4.120. Chi-square test for effect of "Pain as Constant" (Top and Bottom 25%) on MHLC-Doctors

Pain_Constant_Change_String * MHLC_Doctors_Change_String Crosstabulation

Count

		MHLC_Doctors_Change_String		
		Decreased	Increased	Total
Pain_Constant_Change_String	Decreased	14a	34a	48
	Increased	14a	33a	47
Total		28	67	95

Each subscript letter denotes a subset of MHLC_Doctors_Change_String categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.004[a]	1	.947		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	.004	1	.947		
Fisher's Exact Test				1.000	.563
Linear-by-Linear Association	.004	1	.947		
N of Valid Cases	95				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.85.

b. Computed only for a 2x2 table