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The Efficacy Of A Novel Facebook-Based Psychosocial Intervention For Adults With Chronic Pain: A Randomized Clinical Trial

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THE EFFICACY OF A NOVEL FACEBOOK-BASED PSYCHOSOCIAL INTERVENTION FOR ADULTS WITH CHRONIC PAIN: A RANDOMIZED CLINICAL TRIAL

by

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DEDICATION

This work is dedicated to those who experience chronic pain. Though I cannot fully understand, I hear you. To my research participants and patients, thank you for allowing me to be part of your journey, and for being part of mine.

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CHAPTER 1

INTRODUCTION

Chronic pain impacts more than 100 million American adults and an estimated 20% of people worldwide (Institute of Medicine, 2010; Treede et al., 2015). Defined as pain that is ongoing and lasts longer than three months (International Association for the Study of Pain, 2019), chronic pain can cause significant psychological and emotional distress and often limits an individual's ability to fully function. The burden extends to increased healthcare costs, loss of worker productivity, and emotional and financial strain on those in pain and others in their lives. Access to behavioral pain treatments is greatly limited due to lack of awareness, transportation problems, cost, time, comorbid health problems, geography, and stigma (Griffiths et al., 2006; Jerant et al., 2005; Peng et al., 2007). To address the barriers of in-person treatment, researchers have tested online interventions for chronic pain. These interventions, however, typically lack a social component, which means they fail to address the significant social context of pain. As an alternative, online peer-support interventions provide essential social support to people with pain and reduce barriers to in-person treatment.

People with chronic pain have already been turning to the internet for guidance, support, and a sense of community with likeminded peers. Social networking-based groups, in particular, have become increasingly popular among people with chronic conditions. Importantly, these groups allow for interactions between peers and external healthcare professionals to help foster disease management and offer individuals with chronic conditions affordances that are not available in face-to-face treatment, such as flexibility in terms of when, where, and how often people can use it (Merolli et al., 2013). Social networking-based groups can also accommodate evolving real-time needs, which is a key influence over attrition rates (Merolli et al., 2013). These

affordances make such internet-based groups a promising platform for chronic disease intervention and health management in general.

Surprisingly, there have been few controlled tests of the effects of social networking-based groups. Preliminary work suggests that online groups can reduce pain intensity, activity limitation, and helplessness (Bender et al., 2011). But no studies have tested whether professional-led online support groups that include guidance on effective support and communication processes are more effective than patient-led online support groups. In response, we developed a novel Facebook-based psychological intervention that focuses on enhancing social support by connecting participants with peers who also have chronic pain. Using a randomized controlled clinical trial, we aimed to understand the efficacy of this novel intervention and to explore whether a professional-led support group that incorporates psychological intervention components leads to greater effects than support groups alone. This project has substantial significance in that it experimentally studies a naturally-occurring social process by which adults with chronic pain seek help and tests whether clinicians can augment the healing process by guiding these online support groups. If validated, such an approach could substantially reduce barriers to treatment for this critical public health problem and provide an additional tool to address chronic pain.

Theories on Stress and Coping

People with chronic pain deal with daily challenges related to their pain, including pain management, limited mobility, emotional distress, fear of pain getting worse, and relationship difficulties. These pain-related problems may be appraised as exceeding a person's resources and, therefore, contribute to the stress of a person with chronic pain (Lazarus & Folkman, 1984). Though stress may be an inevitable aspect of human life, coping is essential for adaptation. Coping has been defined as "constantly changing cognitive and behavioral efforts to manage specific

external or internal demands that are appraised as exceeding the resources of the person" (Lazarus & Folkman, 1984, p. 141).

People with chronic pain often have negative and maladaptive appraisals about pain and their ability to manage pain. For example, painful sensations may be interpreted as dangerous, leading to avoidance of activities that may trigger or exacerbate pain. Greater use of avoidant behavior as a result of fear of pain predicts higher levels of functional disability (Garland, 2012). In addition, when pain is viewed as overwhelming or uncontrollable, people experience greater pain intensity.

Appraisals can also be made about a person's ability to manage pain. Whether or not individuals with chronic pain believe they are able to cope with a painful sensation impacts the extent to which pain is interpreted as threatening. Individuals' appraisals about their ability to cope also impact their coping responses (Taylor, 2015). The multidimensional nature of chronic pain means that it is unlikely that pharmacological interventions will be sufficient by themselves. A number of treatment modalities can be used to target pain and pain-related problems. People with chronic pain, however, are differentially equipped to manage their pain. Some people employ adaptive pain management strategies, whereas others are prone to persistent despair. Choice of pain management depends upon a variety of internal and external factors (Taylor, 2015). Psychosocial factors, such as social support, are shown to impact appraisals, coping responses, and psychological and physiological outcomes.

Psychosocial Influences on Chronic Pain

Psychological and social factors have an important influence on the persistence and intensity of pain, its impact on function and well-being, and the development of pain-associated disability (Main, 2013). Psychological factors, such as fear, anxiety, and catastrophizing, impact

both the perception of pain and responses to pain. Various pathways have been identified to explain the link between psychological factors and pain outcomes. The gate control theory of chronic pain (Melzack & Wall, 1965) posits that thoughts and feelings can impact pain processing on a neurological level. Pain messages originate in nerves typically associated with damaged tissue and flow along the peripheral nerves to the spinal cord until they reach the brain. According to the gate control theory, before pain messages can reach the brain they encounter "nerve gates" in the spinal cord that open or close depending on a number of factors. When the gates are open, pain messages pass through more or less easily, and pain can be intense. When the gates are closed, pain messages are prevented from reaching the brain and may not even be experienced. Psychological factors, among others, impact the opening and closing of nerve gates. These factors include cognitive factors (e.g., catastrophic thoughts, distraction), emotional factors (e.g., depression, fear, relaxation), and behavioral factors (e.g., activity). Many psychological interventions for chronic pain, such as cognitive behavioral therapy (CBT) and acceptance and commitment therapy (ACT), address cognitions, emotions, and behaviors that prompt and perpetuate pain.

The emotional process-pain model similarly indicates a link between emotions and pain processing. This model assumes that chronic pain develops as a consequence of central sensitization in which the brain and spinal cord, rather than peripheral tissues, are key to generating persistent pain. When central sensitization occurs, the central nervous system enters a persistent state of high reactivity, which lowers the threshold for the experience of pain. The persistent state of reactivity maintains pain even after an initial injury might have healed. In this state, a stimulus that does not usually provoke pain can cause pain (allodynia) or a stimulus that is normally somewhat painful can cause an extreme pain reaction (hyperalgesia).

Neuroscience research indicates that pain pathways in the central nervous system are linked with and influenced by emotions. Emotional processes impact pain in a number of ways (Lumley et al., 2011). Emotional difficulties can arise when people ignore or suppress primary emotions such as anger. Primary emotions are evolutionarily adaptive. Primary anger, for example, is evoked when something of value is taken and motivates defense or attack. Research suggests that the suppression of primary emotions is common and contributes to pain (Lumley et al., 2011). When people suppress primary emotions rather than express or process them, they experience secondary emotions such as depression and anxiety. These secondary emotions are maladaptive and common among people with chronic pain. Psychological interventions for pain that focus on emotions are gaining attention, including mindfulness therapies to increase emotional awareness, emotional experiencing techniques, and emotional expression techniques.

Emotional disclosure is used as an experiential intervention for clinical populations, including chronic pain patients. Emotional disclosure involves writing or talking about stressful experiences and emotions. In two studies on people with fibromyalgia, written emotional disclosure led to benefits in pain and other symptoms (Broderick et al., 2005; Gillis et al., 2006). Findings from a randomized controlled trial on emotional disclosure in adults with cancer pain showed that participants whose narratives had high emotional disclosure reported less pain and greater well-being, compared to participants whose narratives were less emotional (Cepeda et al., 2008). Studies on other pain populations, such as people with rheumatoid arthritis, pelvic pain, and migraines, showed less consistent benefits of emotional disclosure (Lumley et al., 2011). Meta-analyses and studies examining moderators indicate that disclosure may be most beneficial for individuals with unresolved emotional difficulties, who are ambivalent over expressing feelings, who engage in catastrophizing, and have more negative affect (Frattaroli, 2006; Frisina

et al., 2004; Norman et al., 2004). With these individuals in particular, emotional dysregulation and suppression may be a leading cause and perpetuator of chronic pain. Several studies suggest that ambivalence over emotional expression (i.e., having a desire to express one's emotions, but fearing the consequences of doing so) is linked to greater pain, pain behavior, and maladjustment (Carson et al., 2007; Porter et al., 2005; van Middendorp, 2010). Experimental studies further support the relationship between emotional suppression and pain (Burns et al., 2007; Quartana et al., 2007). Burns and colleagues (2007) manipulated emotional suppression in a sample of healthy adults. Findings showed that when participants were instructed to suppress their feelings while being provoked by an experimenter during a mental arithmetic task, they experienced greater pain intensity during the cold pressor test, compared to participants who were encouraged to express their feelings.

Collectively, research on emotional disclosure and pain suggests that emotional suppression can increase pain for some individuals and can be targeted to reduce pain. An issue that researchers have encountered is getting people to disclose, process, and resolve emotional struggles (Lumley et al., 2011). To facilitate engagement with emotional disclosure exercises, Lumley and colleagues suggest using motivational interviewing, providing a clear rationale for disclosure, providing guidance, and using more intensive emotional awareness interventions. Use of an alternate platform, such as the internet, might also increase patients' willingness to disclose personal experiences and emotions. Internet support groups, for example, offer people a safe platform to share their pain-related experiences with others who can relate. The online disinhibition effect suggests that people may feel less restraint when communicating online versus in person.

In addition to psychological factors, social processes are known to impact the pain experience. Pain often occurs in the presence of others, and responses to individuals in pain are known to modulate the experience of pain, including pain intensity, pain tolerance, and pain behaviors (Fordyce, 1976; Krahé et al., 2013; Pester et al., 2020). Researchers have identified a number of mechanisms to explain the relationship between the social environment and pain. There is evidence that social pain, such as rejection or exclusion from others, activates similar neural circuitry as physical pain (e.g., dorsal anterior cingulate cortex (dACC), anterior insula (AI)) (Eisenberger, 2012; Pieritz et al., 2017). Experiencing social pain, therefore, may augment physical pain processing.

Additional social processes, such as social influence and comparison, may influence health outcomes including pain (Berkman et al., 2000; Stroebe & Stroebe, 1996). According to Festinger (1954), people prefer to evaluate themselves using objective and nonsocial standards; however, if such information is unavailable, they will compare themselves using social information such as other people. Individuals assess the appropriateness of their own attitudes, beliefs, and behaviors with those of their reference group members, often altering their own to match those of the group. Social influence can occur simply through observing and comparing oneself with one's social network, without persuasion from others (Thoits, 2011). Social comparison provides information about norms regarding health behaviors, such as the appropriateness of using alcohol or drugs, exercising, complying with medical regimens, and behaviors for managing pain (e.g., use of pharmacotherapy). Notably, reference groups can model both damaging and protective health behaviors (Cohen, 1988b). The consequences of social comparison, therefore, depend on the person's reference group and the predominant health beliefs and behaviors within the group.

Similar to social comparison, social support is shown to have a variable influence on pain and well-being. Thoits (2011) acknowledges the "dark sides" of social relationships. Relationships that are tense, conflicted, or overly demanding can exacerbate distress. Even well-intentioned acts of support can offend, cause distress, and increase pain. For example, empathic responses from close others, such as providing help or taking over a task, may reinforce pain behavior, resulting in increased or prolonged pain severity and disability (Fordyce, 1976). A study by Romano et al. (2000) found that when family members or healthcare providers were overprotective or overly solicitous, people with chronic pain experienced increased pain and distress, and reported higher levels of physical disability.

Yet, the literature overwhelmingly suggests that social support is positively and causally related to mental health, physical health, and longevity, and buffers the harmful effects of stress exposure (Thoits, 2011). In particular, the effects of *perceived* support seem to be stronger and more consistently beneficial for mental and physical health compared to *received* support (i.e., actual support provisions). Social support is typically provided by members of a person's primary and secondary groups. Primary groups tend to be small, informal, intimate, and enduring (e.g., family members), whereas secondary groups tend to be larger, more formal, less personal, and variable in duration (e.g., co-workers). Social support offered by group members includes emotional (e.g., sympathy, caring, encouragement), informational (e.g., providing facts or advice), and instrumental assistance (e.g., providing behavioral or material assistance). Daily emotional, informational, and instrumental acts are helpful in themselves and also may sustain self-esteem, a sense of mattering to others, and a sense of control over minor or impending obstacles, thereby indirectly maintaining psychological and physical well-being. Thus, social support may be particularly beneficial for people with chronic pain conditions, who deal with daily psychological

and physical obstacles. Social cognitive theories suggest that having an encouraging support network, including supports who are successfully managing the same illness, can enhance patients' beliefs in their coping abilities, help them evaluate stressors as less threatening, and lead to mastery experiences and adaptive health behaviors (Bandura, 1977; Brownson & Heisler, 2009; Clark & Dodge, 1999; Cobb, 1976; Cohen & Wills, 1985; Thoits, 1986). For that reason, social support has been identified as a key component of chronic disease management, including coping and promoting lifestyle change (Funnell, 2010).

One type of supportive response, *emotional validation*, has been shown to benefit people with chronic pain. Validation is a form of emotional support characterized by acknowledgement, understanding, and acceptance of a person's experience (Linehan, 1993, 1997). Broadly, validation is a positive response style that appears to benefit all individuals and, thus, is included as a core intervention in psychotherapies such as dialectical behavior therapy (DBT), an empirically-supported treatment for borderline personality disorder (Lynch et al., 2006). Validation may impact pain, in particular, in a number of ways. Consistent with a biosocial model, validation may decrease emotional arousal, and in turn, attenuate pain intensity and pain behavior (Edmond & Keefe, 2015). Alternatively, validation may reduce pain by increasing intimacy, positive affect, and relationship satisfaction, in line with the interpersonal process model of intimacy (Reis & Shaver, 1988). Intimacy and interpersonal closeness have been shown to modulate biological responses to pain (Krahé et al., 2013).

Emotional validation may be particularly important for individuals with chronic pain because they often experience emotional distress related to their pain, including fear that pain will escalate, anger at pain-related interference in daily activities, and sadness that they missed out on experiences because of pain. Adding to their emotional distress, people with chronic pain report

feeling unheard, misunderstood, or invalidated by medical professionals, friends, and loved ones (Kool et al., 2009; Leong et al., 2011; Sternke et al., 2016; Wernicke et al., 2017). Individuals with chronic pain may worry about whether their caregivers can be relied upon to provide validation when they are upset because of pain-related concerns (Reich et al., 2006).

Reviews of studies on pain and validation reveal that validation is related to reduced pain, perceived support, and relational satisfaction (Cano et al., 2008; Leong et al., 2015). Conversely, invalidation, or a response that conveys a lack of understanding, rejection, and/or criticism, has been linked to increased physiological arousal, negative affect, emotional inhibition, negative relational effects, and pain-related impairment (Cano et al., 2008; Edmond & Keefe, 2015; Fruzzetti et al., 2005; Greville-Harris et al., 2016; Krause et al., 2003; Leong et al., 2011; Shenk & Fruzzetti, 2011; Wernicke et al., 2017).

There are limited and mixed findings on the impact of experimentally-manipulated validation on individuals with chronic pain. Edlund and colleagues (2015) provided a 45-minute validation training to close loved ones of adults with chronic pain. Before and after the validation training, dyads were instructed to discuss a topic that evoked negative emotions. Following the validation training, close others exhibited more validating and fewer invalidating responses during discussions, as assessed by trained coders. In turn, the partner with chronic pain reported a decrease in negative affect from pre- to post-training. Surprisingly, there was no evidence that validation affected pain intensity in participants with chronic pain. Another study randomly assigned nurses with recurrent back pain to receive either a validating or an invalidating semi-structured interview about pain (Vangronsveld & Linton, 2012). Those in the validation condition reported greater satisfaction and less frustration with the interview compared to those in the invalidation condition. These studies indicate that validation can be trained and may be beneficial for adults with chronic

pain. However, contrary to theory, these findings do not offer support for the impact of validation on pain intensity itself.

Conclusion. Chronic pain is complex, and it is still unknown exactly what causes and maintains it. The pain literature indicates that chronic pain is influenced by biological, psychological, and social factors. A multimodal approach to pain treatment is, therefore, considered the gold standard. Multidisciplinary pain treatment can include physical therapy, occupational therapy, interventional treatments (e.g., steroid injections, spinal cord stimulators), pharmacotherapy (e.g., opioids), psychotherapy (e.g., cognitive behavioral therapies, emotional awareness and expression therapy), and social support (e.g., chronic pain support groups). Access to psychosocial treatment, in particular, is greatly limited due to lack of awareness, transportation problems, cost, time, comorbid health problems, geography, and stigma (Griffiths et al., 2006; Jerant et al., 2005; Peng et al., 2007). Alternate methods for delivering behavioral pain treatments are needed to increase access to effective care.

Internet-Based Interventions for Chronic Pain

To address the barriers of in-person treatment, researchers have tested online interventions for chronic pain. The internet opens new possibilities for people restrained by physical or mental disability to seek information and social support. Many of these online interventions, however, are individualized and lack a social component (Lorig et al., 2008; Ruehlman et al., 2012), which means they fail to address the significant social context of pain. As an alternative, online peer-support interventions provide essential social support to people with pain and reduce barriers to in-person treatment.

People with chronic pain have already been turning to the internet for guidance, support, and a sense of community with likeminded peers. Social networking-based groups, in particular,

have become increasingly popular among people with chronic conditions. Through online groups, adults with chronic pain seek and provide support to one another, which is important for individuals with pain who otherwise become isolated as a result of mobility problems (Rodham et al., 2009). Importantly, these groups allow for interactions between peers and external healthcare professionals to help foster disease management and offer individuals with chronic conditions affordances that are not available in face-to-face treatment, such as flexibility in terms of when, where, and how often people can use it (Merolli et al., 2013). Social networking-based groups can also accommodate evolving real-time needs, which is a key influence over attrition rates (Merolli et al., 2013). These affordances make such internet-based groups a promising platform for chronic disease intervention and health management in general.

Surprisingly, there have been few controlled tests of the effects of social networking-based groups on adults with chronic pain. Preliminary work suggests that online groups can reduce pain intensity, activity limitation, and helplessness (Bender et al., 2011). Social networking-based groups, specifically, may have a positive impact on health status and psychological factors such as emotional burden, catastrophizing, pain-induced fear, depression, and anxiety, with no evidence of adverse effects (Merolli et al., 2013). Though social networking-based groups are shown to reduce pain in children and adolescents (Bender et al., 2011), the impact of these groups on physical symptoms has yet to be investigated in adults.

Gaps in the literature. Research is needed to better understand the psychological and physical impact of online support interventions on adults with chronic pain. There are no prior studies that use a randomized controlled trial to compare online peer support alone versus peer support blended with psychological interventions to test whether incorporating psychological interventions improve adjustment above and beyond peer support alone. Unstructured online

support groups are currently available to individuals with chronic pain, yet the effects of these groups are unknown. Experimental studies that systematically examine the impact of online support interventions are essential to inform treatment recommendations for adults with chronic pain.

The Current Study

This research addresses gaps in the chronic pain literature. We developed a novel Facebook-based psychological intervention that focuses on enhancing social support by connecting participants with peers who also have chronic pain. Using a randomized controlled clinical trial, we aimed to understand the efficacy of this novel intervention and to explore whether a professional-led support group that incorporates psychological intervention components leads to greater effects than support groups alone.

In this study, adults with chronic nonmalignant pain were randomly assigned to a control (peer-led) or experimental (professional-led) condition. Both conditions involved engagement in a private Facebook group, in which participants could provide and receive peer support. In the control (peer-led) condition, participants were instructed to offer mutual support for the duration of the group, whereas in the experimental (professional-led) condition, the investigators disseminated several training components that were selected based on research on social and emotional influences on pain. Intervention components included psychoeducation on pain neurobiology, emotional validation training, emotional disclosure exercises, and prompts to engage participants in activities that they have been avoiding because of their pain. Training materials included short didactics to read, videos to watch, prompts to respond to, and activities to engage in. Participants engaged in their assigned Facebook group for four weeks. The investigators

followed the groups and collected quantitative data, including number of posts and self-reported outcomes assessed at baseline, weekly, post-intervention, and 1-month follow-up.

This project has substantial significance in that it experimentally studies a naturally-occurring social process by which adults with chronic pain seek help and tests whether clinicians can augment the healing process by guiding these online support groups. If validated, such an approach could substantially reduce barriers to treatment for this critical public health problem and provide an additional tool to address chronic pain. Consistent with prior research on pain education, validation training, emotional disclosure, and behavioral avoidance in chronic pain patients, it was hypothesized that experimental condition participants would show greater benefits (reduced pain severity and interference, improved psychological status) than controls. Thus, this study had the following aims and hypotheses:

Aim 1: To understand how Facebook-based support groups impact adults with chronic pain. Based on the social support literature, individuals who participate in social networking-based groups may experience social pain, social comparison, social support, and validation. Though the precise social dynamics that occur within Facebook-based support groups for chronic pain are unknown, theory suggests that having an encouraging support network, including supports who are successfully managing the same illness, can enhance patients' beliefs in their coping abilities, help them evaluate stressors as less threatening, and lead to mastery experiences and adaptive health behaviors. Preliminary work similarly indicates that online groups can lead to improvements in helplessness, pain intensity, and activity limitation (Bender et al., 2011). Support through social media, in particular, has been shown to have a positive impact on health status and psychological factors including emotional burden, catastrophizing, pain-induced fear, depression, and anxiety, with no evidence of adverse effects (Merolli et al., 2013). Both experimental and control

conditions, therefore, were expected to show improvements in pain severity, pain interference, depression, and anxiety from baseline to post-intervention (Hypothesis 1). Consistent with prior research on pain education, validation training, emotional disclosure, and behavioral avoidance in chronic pain patients, it was hypothesized that experimental participants would show greater benefits than controls (Hypothesis 2). Exploratory analyses were conducted to examine longer-term effects (1-month follow-up).

Aim 2: To determine for whom Facebook-based support groups are most beneficial. Research suggests that social support and validation buffer the harmful effects of stress exposure and are related to reduced pain and improved mental and physical health. Those who feel unheard, misunderstood, or invalidated by friends and family members may experience increased pain and distress as a result, and therefore, would benefit from support and validation from likeminded peers. Therefore, participants reporting greater perceived social constraints at baseline were expected to show greater improvements in pain severity, pain interference, depression, and anxiety from baseline to post-intervention, compared to those who perceived their friends and family members as being more supportive and validating (Hypothesis 3). Perceived social constraints was examined first as a moderator to determine whether the effects of condition on outcomes differed depending on participants' level of perceived social constraints. We subsequently tested the main effect of perceived social constraints as a predictor of outcomes independent of condition.

Further, participants in this study had the opportunity to disclose pain-related experiences and emotions to group members, particularly those in the experimental condition. The literature suggests that disclosing emotions benefits pain and other symptoms and may be most beneficial for individuals who are ambivalent over expressing feelings, as emotional suppression may be a leading cause and perpetuator of their chronic pain. Thus, participants who were more ambivalent

or conflicted about expressing their emotions were expected to show greater benefits than less ambivalent participants (Hypothesis 4). Ambivalence over emotional expression was tested as both a moderator and predictor. Finally, exploratory analyses examined other possible moderators and/or predictors, including type of chronic pain condition (chronic primary pain versus other pain condition) and Facebook group engagement (Lurker versus Active User).

Exploratory: Because of the novelty of this social networking-based intervention, we examined the acceptability of the Facebook support groups by evaluating participants' satisfaction with their experience, preferences, and potential adverse events including invasion of privacy. Group differences in satisfaction were investigated.

CHAPTER 2

METHOD

Participants

The study sample was 119 adults with chronic nonmalignant pain. Participants were recruited through advertisements on Facebook, Reddit, Twitter, Craigslist, and Wayne State University Academica. In addition, participants from prior studies in the Relationships and Health Laboratory who gave consent to be contacted for future studies were contacted via e-mail. To participate in the current study, individuals had to: a) be at least 18 years old; b) have chronic pain (i.e., pain that persists for at least 3 months); c) be fluent at reading and writing in English; d) have an active Facebook account; and e) check Facebook at least three times per week. Individuals were not eligible to participate if they had pain related to a terminal illness, such as cancer, or active psychosis.

Procedure

The study was approved by the Wayne State University Institutional Review Board and registered with ClinicalTrials.gov (NCT04010019) before recruitment, which occurred from September 2019 through January 2020, with follow-up assessments completed in April 2020. The recruitment advertisements and e-mails contained an introduction to the study and a link to a Qualtrics survey to verify eligibility. The Qualtrics survey told potential participants:

> "The goal of this study will be to learn more about online social support groups for chronic pain. If you are eligible, you will be asked to join a private Facebook group that has been created by the researchers for this study. This group is designed to be a social support group for individuals who experience chronic pain. You will be able to connect with others who also have pain, offer and receive support, and share your pain-related experiences. You will be asked to complete online questionnaires before and after participating in the Facebook group, and will be compensated for doing so. If you are interested in this study and want to see if you are eligible, please answer the following questions. This survey will take less than 5 minutes. After you complete this survey, we will review your responses and e-mail you to let you know if you are eligible to participate."

The researchers notified individuals of their eligibility status via e-mail. Eligible individuals were given an estimated timeframe for when the group would begin. They were told that they would receive an e-mail one week before the group starts and to inform the researchers if they were no longer interested in participating in the study. A copy of the electronic informed consent was attached to the e-mail. Participants were instructed to read the informed consent and then click a link to a Qualtrics survey where they could electronically sign the consent form. As part of the consent process, participants were told that they would be randomly assigned to one of two social support Facebook groups and were given brief descriptions of each group. Both researchers and participants were blind to condition assignment until after baseline measures were completed.

A total of 80 to 90 eligible individuals were targeted per round, with the goal of having 25 to 35 participants per experimental and control groups. Once 80 or more individuals consented to participate, a date was set for the two groups to begin simultaneously. Consented individuals were sent an e-mail one week before the start date. In the e-mail body, participants were notified of the group start date, provided instructions for joining the Facebook group, and directed to a Qualtrics survey to complete baseline measures, which required 25 to 35 minutes. Participants were given a unique study ID to input when completing study measures.

Two days prior to the study start date, individuals who completed baseline measures were randomized to either the experimental condition (professional-led Facebook group) or control condition (peer-led Facebook group) using a Microsoft Excel randomization generator. Randomization was stratified by gender and conducted in blocks of 4 so that experimental conditions had equal numbers of participants after filling each block. Both conditions involved engagement in a *secret* Facebook group, which meant participants had to be invited to the group via a private link and then approved by the group administrator (i.e., the investigators of this study).

Only group members had access to the group's name, description, membership, and posts. The group name and its members could not be found using a public search; therefore, individuals not involved in the study could not request to join the group or see group content. As stated in the consent form, group members were able to see the Facebook profile names and public photos of other group members, but they were provided instructions on how to make their profiles private if they preferred. Additionally, participants were discouraged from becoming Facebook friends with other participants throughout the duration of the study.

Participants engaged in their respective Facebook groups for 4 weeks, as frequently as each participant desired; this timeframe was selected for logistical reasons (e.g., to minimize attrition, to stay consistent with the brief 28-day experimental intervention). Each Facebook group contained 28 to 32 participants. A total of four Facebook groups were conducted for this study (two groups per experimental condition). The two groups (one for each condition) were run simultaneously to control for any confounds due to timing or social events. The first set of groups (an experimental and a control group) ran from September to December 2019 and the second set ran from January to April 2020, including baseline and follow-up assessments.

Participants were e-mailed brief (5-10 minute) weekly measures during the Facebook group. After the 4-week Facebook group terminated, participants were e-mailed a link to complete post-intervention measures, which took 20 to 30 minutes. One month later, participants received an e-mail with a link to a Qualtrics survey where they completed 20 to 30 minutes of follow-up measures. Participants were compensated for completing assessments with Amazon gift cards. They received $15 for completing baseline, post-intervention, and follow-up measures, totaling up to $45 if they completed all three.

Experimental Conditions

Control condition (peer-led Facebook group). Participants assigned to the control condition participated in a secret Facebook group similar to the chronic pain Facebook groups that occur naturally. The investigators, who served as group moderators, rarely interacted with participants in the control condition aside from welcoming participants to the group, asking participants to briefly introduce themselves, engaging participants in an icebreaker activity, and posting weekly reminders to maintain engagement (see Appendix A). Thus, the control condition was almost exclusively peer-led.

Experimental condition (professional-led Facebook group). Participants assigned to the experimental condition participated in a secret Facebook group for chronic pain that was moderated by the investigators and offered psychosocial interventions for pain. The investigators interacted with participants from a Facebook profile that was created for this study. Interactions included posting in the Facebook group nearly every morning and reacting to participants' posts (e.g., liking posts) occasionally. The investigators followed a schedule of disseminating several training components that were selected based on research on social and emotional influences on pain (see Appendix A). Training materials included short didactics to read, videos to watch, prompts to respond to, and activities to engage in. Our team consulted a chronic pain patient advocate on intervention materials, including content, wording, and formatting, and modified our approach accordingly. Training components included the following:

1. **Introductions and icebreaker (days 1 to 2)**: The investigators welcomed participants to the group, asked participants to briefly introduce themselves, and engaged participants in an icebreaker activity with the goal of building group rapport.

2. **Pain neurobiology education (days 3 to 4)**: The investigators provided education about pain, including information about the biological, psychological, and social causes of chronic pain. Psychoeducation on pain neurobiology, which, when combined with other biopsychosocial treatments, can lead to clinically significant improvements in pain and disability (Moseley & Butler, 2015). Psychoeducation was delivered mainly through brief, engaging videos available online (e.g., a 5-minute animated video created by pain scientist, Dr. Lorimer Moseley) and written material. Participants were asked to watch the videos and respond to the group with comments or questions.
3. **Emotional validation training (days 5 to 10)**: The investigators provided education about validation and how it can impact pain and distress. Validation training was provided to teach participants how to validate one another within the group, including how to convey understanding of another's emotional or physical experience. Validation training was based on prior work that colleagues and I have conducted (Cano et al., 2008; Leong et al., 2015; Pester et al., 2020). Emotional validation has been shown to benefit people with chronic pain, who experience pain-related distress but often feel invalidated by medical professionals, friends, and loved ones.
4. **Emotional disclosure (days 11 to 19)**: The investigators posed open-ended questions to encourage participants to tell personal stories about their pain journeys and make emotional disclosures, which have been shown to be helpful in people with pain (Lumley et al., 2011, 2012) (e.g., "How has pain impacted your life? How has your life impacted your pain?"). Participants were encouraged to respond to other group members using their newly acquired validation skills.

5. **Overcoming avoidance (days 20 to 26)**: The investigators encouraged participants to reflect on what they avoid because of their pain (e.g., activities they used to enjoy). Education about the benefits of movement was provided, along with prompts to engage participants in activities they have been avoiding because of their pain, as greater use of avoidant behavior as a result of fear of pain is associated with higher levels of functional disability (Garland, 2012).
6. **Termination (days 27 to 28)**: The investigators reminded participants that the Facebook group was ending, thanked participants for their participation, and encouraged participants to share any final thoughts or messages.

Measures

Table 1 depicts the measures that participants completed for this study and when they were completed. All self-report measures were completed remotely through Qualtrics, an online survey tool. Baseline measures were administered to participants one week prior to the start date of the Facebook group, before random assignment of conditions. Weekly measures were administered to participants during the duration of the Facebook group, at the end of each week (weeks 1, 2, and 3). Post-intervention measures were administered to participants immediately after the Facebook group ended (week 4). Follow-up measures were administered to participants one month after the Facebook group ended.

Table 1: *Overview of Administration of Measures*

Measures	Baseline	Weekly	Post-Intervention	1-Month Follow-Up
Demographics	X			
General Social Constraints Scale (GSC)	X			
Ambivalence over Emotional Expressiveness Questionnaire (AEQ)	X			
Facebook Group Engagement		X	X	
Brief Pain Inventory (BPI): Pain Severity	X		X	X
Brief Pain Inventory (BPI): Pain Interference	X		X	X
PROMIS® Emotional Distress – Depression – Short Form 8a v1.0	X		X	X
PROMIS® Emotional Distress – Anxiety – Short Form 8a v1.0	X		X	X
Acceptability items			X	

Potential Moderators and/or Predictors

Demographics. Participants reported on their age, gender, race/ethnicity, relationship status, education level, employment status, place of residence, access to health insurance, access to transportation, chronic pain diagnosis, length of chronic pain, current pain treatment including medication, and current engagement in other Facebook groups for chronic pain.

Perceived social constraints. On the 15-item General Social Constraints Scale (GSC; Lepore & Ituarte, 1999), participants rated how often friends or family members respond to them in ways that suggest that the participant should conceal, avoid, or minimize sharing problems or concerns (Appendix B). Items were rated from 1 (*never*) to 4 (*often*) and summed, with higher scores indicating more perceived social constraints. The GSC has been shown to have excellent internal consistency among some medical populations (Lepore & Revenson, 2007) and had excellent internal consistency in our sample ($\alpha = 0.94$).

Ambivalence over emotional expression. On the 14-item version of the Ambivalence over Emotional Expressiveness Questionnaire (AEQ), participants rated their ambivalence or conflict over the external expression of their feelings (Appendix C). Items were rated from 1 (*I*

have never felt like this) to 5 (*I feel like this a lot*) and averaged, with higher scores indicating greater ambivalence over emotional expression. The AEQ has demonstrated good reliability and, as expected, correlates negatively with psychological well-being and life satisfaction (King & Emmons, 1990). In our sample, the scale had excellent internal consistency ($\alpha = 0.92$).

Facebook group engagement. (1) Self-report measures of engagement: Frequency of Facebook group use was assessed via self-report at the end of each week (a total of four times). Participants were asked: "Over the past 7 days, how many days did you visit the Facebook group (*0 days*, *1 day*, *2 days*, *3 days*, *4 days*, *5 days*, *6 days*, or *7 days*)? Please answer this question whether you actively posted and commented, or just observed and read what others were saying and did not post or comment yourself." A composite score was computed for the average number of days that participants visited the Facebook group each week, as well as the total number of days they visited the group during the entire four-week (28-day) intervention. Post-intervention, participants were asked whether they considered themselves to be Lurkers, Active Users, or Non-users. A lurker is defined as "anyone who reads but seldom if ever publicly contributes to an online group" (Nonnecke & Preece, 2003, p. 110). Participants reflected on their engagement with the Facebook group over the past four weeks and classified themselves as either Lurkers (*Yes, I would consider myself a lurker because I visited the Facebook group regularly, but rarely, if ever, posted*), Active Users (*No, I would not consider myself a lurker because I visited the Facebook group regularly and posted/commented frequently*), or Non-users (*No, I would not consider myself a lurker because I rarely visited the Facebook group*). **(2) Objective measures of engagement**: Participants' total number of posts and comments in the Facebook group were obtained.

Primary Outcome Measures

Pain severity and interference. The Brief Pain Inventory (BPI) was administered to assess participants' pain severity and interference from pain across six time points (Cleeland, 1991). Four items were used to capture pain severity over the past week: pain at its "worst," "least," "average," and "now" (current pain) (Appendix D). Participants rated each item on a scale from 0 (*no pain*) to 10 (*pain as bad as you can imagine*). A composite of the four pain items (a mean severity score) was computed and used in analyses. Seven items were used to capture the extent to which pain had interfered with general activity, mood, walking ability, normal work, relationships, sleep, and enjoyment of life in the past week (Appendix E). Participants rated each item on a scale from 0 (*does not interfere*) to 10 (*completely interferes*). A composite of the seven interference items (a mean interference score) was computed. The Brief Pain Inventory has been validated in a chronic nonmalignant pain population and demonstrates acceptable internal consistency and sensitivity to pain (Tan et al., 2004). In our sample, both the pain severity and pain interference items had acceptable to excellent reliability at (1) baseline (pain severity, $\alpha = 0.87$; pain interference, $\alpha = 0.89$), (2) post-intervention (pain severity, $\alpha = 0.89$; pain interference, $\alpha = 0.92$), and (3) 1-month follow-up (pain severity, $\alpha = 0.89$; pain interference, $\alpha = 0.92$).

Depression and anxiety. Symptoms of depression and anxiety were assessed using brief (8-item) self-report measures developed by the Patient-Reported Outcome Measurement Information System (PROMIS®). PROMIS® has developed a number of measures of physical, mental, and social health for use with the general population and with individuals living with chronic conditions. PROMIS® measure development methods are rigorous, and substantial qualitative and quantitative evidence supports the validity of these measures. PROMIS® instruments are shown to be reliable measures of symptoms and have greater precision than most

conventional measures (Cella et al., 2010). PROMIS® short forms for measuring emotional distress provide information comparable to legacy measures (Pilkonis et al., 2011), and scores are sensitive to change (Schalet et al., 2016). The PROMIS® Emotional Distress – Depression – Short Form 8a version 1.0 (Appendix F) was used to assess depression, including negative mood and views of self, and the PROMIS® Emotional Distress – Anxiety – Short Form 8a version 1.0 (Appendix G) was used to assess anxiety, including fear, anxious misery, and hyperarousal. Participants were asked to indicate the degree to which they experienced each of eight items in the past week on a scale from 1 (*never*) to 5 (*always*). A composite score of the eight items (mean depression and anxiety scores) were computed. The reliability of depression items was excellent in our sample at baseline ($\alpha = 0.96$), post-intervention ($\alpha = 0.96$), and 1-month follow-up ($\alpha = 0.96$). Anxiety items also had excellent reliability at baseline ($\alpha = 0.95$), post-intervention ($\alpha = 0.94$), and 1-month follow-up ($\alpha = 0.94$).

Exploratory Outcomes

Acceptability. Participants' experiences with their Facebook group were assessed using questions designed for this study (see Appendix H). Participants were asked to rate their satisfaction with various aspects of the experience on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Participants in the experimental condition additionally rated their satisfaction with each intervention component from 1 (*I did not like this activity*) to 5 (*I loved this activity*). To evaluate potential adverse events, participants indicated (*yes* or *no*) if they experienced an invasion of privacy by participating in their Facebook group. If yes, participants were asked to describe their experience.

Statistical Analyses

Sample size was determined by power analysis to test the difference between the experimental and control conditions. No reliable estimates of expected effect sizes were known, so we powered this study to detect a medium effect (0.50 *SD*), which we felt was clinically meaningful. To obtain 80% power using an analysis of variance (ANOVA) with two-tailed alpha of 0.05 required a total sample size of 120 participants.

All data were analyzed using IBM SPSS Statistics, Version 27. Prior to conducting analyses, data were screened for outliers, normality, non-random missing data, and other parametric assumptions. Outliers were detected by examination of standardized scores for values greater than +/-3.29 (Tabachnick & Fidell, 2007). No univariate outliers were found. All variables were found to have normal distributions, with no significant skew or kurtosis. Primary analyses were intent-to-treat of the full randomized sample, including participants who did not provide weekly, post-intervention, or 1-month follow-up data. Missing data were replaced via regression imputation (see Appendix I). Of the measures that were completed, very little data (i.e., individual items) were missing, and all data were found to be missing at random. Random missing data were extrapolated from participants' own data (see Appendix I).

To assess the success of randomization, preliminary analyses compared the experimental and control conditions on demographics and baseline values of outcome measures using t- and chi-square tests. Pearson correlations among all key variables at each time point were calculated using the overall sample for descriptive purposes and to examine the relationships among variables. T- and chi-square tests were used to ensure participants in the experimental and control conditions did not differ in level of engagement with their respective Facebook groups.

Aim 1: To determine whether participants within conditions improved in pain severity, pain interference, depression, and anxiety from baseline to post-intervention (Hypothesis 1) and whether experimental participants showed greater benefits than controls (Hypothesis 2), two-way mixed design analyses of variance (mixed design ANOVA) were conducted, with time (baseline, post-intervention, and/or 1-month follow-up) as the within-subjects factor and group (experimental and control) as the between-subjects factor. These analyses were followed up with paired sample t-tests examining changes in outcomes over time (baseline, post-intervention, 1-month follow-up) among experimental and control conditions separately. Given potential group differences in baseline levels of outcome variables, analyses of covariance (ANCOVA) were also used to compare the two conditions on each outcome measure at post-intervention and 1-month follow-up, covarying the baseline value of the outcome. Because participants in the first and second wave of this study did not differ in any of the outcomes across time points, wave was not included as a covariate in analyses. All tests were two-tailed with alpha set at .05. Between-condition effect sizes for ANOVAs were calculated using partial eta squared (η_p^2); effect sizes are generally considered small at $\eta_p^2 = 0.01$, medium at $\eta_p^2 = 0.06$, and large at $\eta_p^2 = 0.14$ (Cohen, 1988). Within-condition effect sizes for t-tests were calculated using Cohen's *d* (mean difference divided by the pooled standard deviation of the change scores) and interpreted as small ($d = 0.2$), medium ($d = 0.5$), and large ($d = 0.8$) (Cohen, 1988).

Aim 2: Moderation analyses were conducted to examine for whom the Facebook-based support groups were most beneficial. The PROCESS macro in SPSS (Hayes, 2013) was used to conduct tests of moderation for continuous variables: baseline perceived social constraints (Hypothesis 3) and baseline ambivalence over emotional expression (Hypothesis 4). First, change scores in the four outcome measures were calculated; baseline values of each outcome measure

were subtracted from values at post-intervention and 1-month follow-up. These changes in outcome variables served as the dependent variables in the current analyses. PROCESS Model 1 tested interactions between a moderator and experimental condition on changes in outcome measures. Eight parallel sets of analyses were run, wherein the experimental condition was compared with the control condition, for each of the two potential moderators on each treatment outcome change score, at each time point. No covariates were included in these analyses. To test for the significance of effects, we obtained 95% bias-corrected bootstrapped confidence intervals based on 1,000 bootstrapped samples. Any significant interactions were then probed by plotting values of 1.0 SD above and below the mean of the moderator. Potential dichotomous moderators (type of chronic pain condition, Facebook group engagement) were tested using mixed design ANOVAs. Each variable was added to the model to test for moderation (condition x time x moderator) and/or predictors of change (predictor x time) across time points (baseline, post-intervention, 1-month follow-up) in each of the four outcomes.

Exploratory analyses: Descriptive statistics were used to summarize participants' self-reported satisfaction, preferences, and adverse events. T- and chi-square tests were used to test for group differences in acceptability items.

CHAPTER 3

RESULTS

Participant Characteristics and Preliminary Analyses

Figure 1 depicts patient flow through the study. A total of 381 individuals were screened electronically via a Qualtrics survey, but the majority (n = 262, 68.8%) were excluded because they were not interested or able to participate (42.5%), did not meet study criteria (25.7%), or could not be reached via e-mail (0.5%). A final sample of 119 adults met criteria and were randomized (experimental/professional-led Facebook group condition, n = 59; control/peer-led Facebook group condition, n = 60). All 119 participants remained in their assigned Facebook group for the duration of the study and were included in analyses. That is, none of the participants left the Facebook groups early, even if they did not complete weekly or post-intervention assessments. Figure 1 shows the number of participants in each condition who completed baseline, weekly, post-intervention, and 1-month follow-up measures. The experimental condition had somewhat lower completion rates than the controls, although the conditions did not differ significantly (week 1: $\chi^2(1) = 2.25$, $p = .133$; week 2: $\chi^2(1) = 2.63$, $p = .105$; week 3: $\chi^2(1) = 1.82$, $p = .178$; post-intervention: $\chi^2(1) = 2.60$, $p = .107$; 1-month follow-up: $\chi^2(1) = 1.82$, $p = .178$). At each time point, participants who completed measures did not differ significantly from non-completers in terms of demographics or baseline levels of the predictor or outcome measures.

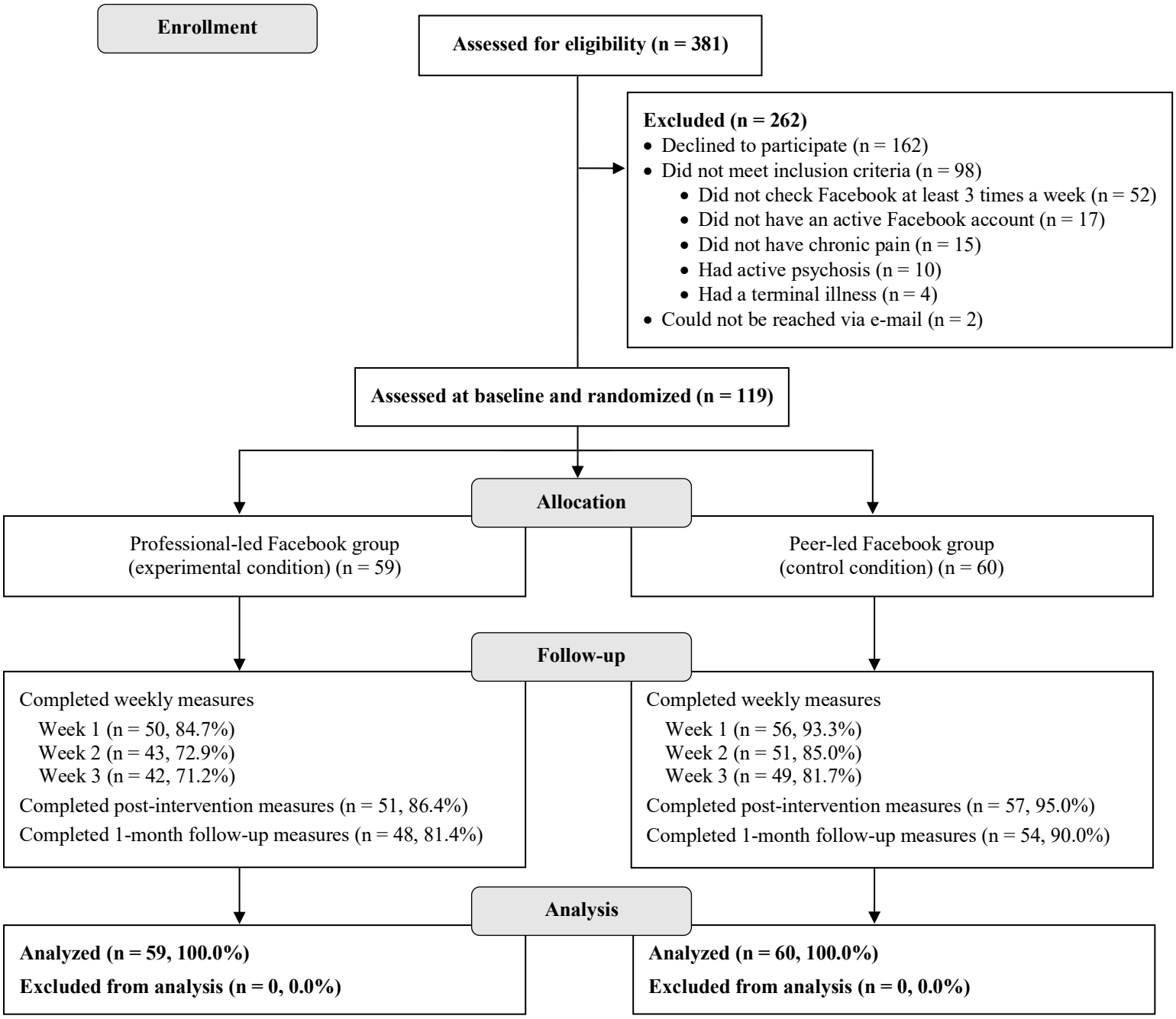

Figure 1: CONSORT diagram displaying study enrollment, randomization, participation, and follow-up.

As shown in Table 2, the overall sample of 119 participants resided predominantly in the United States (US). Of those living in the US, 44.9% lived in Michigan, and the remaining 55.1% were dispersed across 26 other states.

Table 2: *Geographical Breakdown of the Sample*

Continent, country, or state	*n* (%)
Africa	1 (0.8)
Canada	2 (1.7)
Europe	9 (7.6)
United States[1]	107 (89.9)
Michigan	48 (44.9)
California	7 (6.5)
New York	6 (5.6)
Texas	6 (5.6)
Florida	4 (3.7)
Maryland	3 (2.8)
Minnesota	3 (2.8)
Washington	3 (2.8)
Colorado	2 (1.9)
Maine	2 (1.9)
Massachusetts	2 (1.9)
Ohio	2 (1.9)
Oregon	2 (1.9)
Tennessee	2 (1.9)
Utah	2 (1.9)
Wisconsin	2 (1.9)
Alaska	1 (0.9)
Arizona	1 (0.9)
Connecticut	1 (0.9)
Illinois	1 (0.9)
Indiana	1 (0.9)
Nevada	1 (0.9)
New Jersey	1 (0.9)
North Carolina	1 (0.9)
Oklahoma	1 (0.9)
Pennsylvania	1 (0.9)
Virginia	1 (0.9)

[1]Breakdown of participants residing in the United States.

The participants were primarily women, young to middle aged (M = 35.24 years, SD = 13.67; overall age range was 18 to 75 years), White, partnered, and employed; and had, on average, 4 years of college education (57.1% had a bachelor's degree or higher) (see Table 3). Nearly all participants reported having health insurance (94.1%) and access to transportation (96.6%). Participants had a wide range of chronic pain syndromes (see Table 4), with the majority reporting a chronic primary pain condition (e.g., headaches/migraines, back pain, fibromyalgia). Participants' average length of chronic pain was 9.72 years, and most participants reported using pain medication. Nearly a quarter of participants belonged to a Facebook group for chronic pain prior to starting this study.

Independent samples t-tests and chi-square tests of independence were conducted to test whether participants in the experimental and control conditions differed on demographics and study variables at baseline. Results indicate that randomization did not create entirely equivalent conditions. Though the two conditions were similar on most demographics (see Tables 3 and 4) and baseline levels of predictor and outcome measures (see Table 5), a greater proportion of the control condition reported using pain medication at baseline compared to experimental participants. Control participants also reported significantly greater pain interference and anxiety at baseline than those assigned to the experimental condition (see Table 5).

Table 3: *Comparison of Conditions on Demographic Measures at Baseline*

Variable	Full sample (*N* = 119)	Exp. condition (*n* = 59)	Ctrl. condition (*n* = 60)	t/χ^2	*p*
Age in years, *M (SD)*	35.24 (13.67)	35.61 (13.67)	34.88 (13.78)	-0.29	.77
Years of education, *M (SD)*	16.06 (2.64)	16.03 (2.75)	16.06 (2.64)	0.10	.92
Gender				0.00	.97
Man, *n* (%)	12 (10.1)	6 (10.2)	6 (10.0)		
Woman, *n* (%)	101 (84.9)	50 (84.7)	51 (85.0)		
Female to male transgender, *n* (%)	2 (1.7)	0 (0.0)	2 (3.3)		
Androgynous/genderqueer, *n* (%)	3 (2.5)	2 (3.4)	1 (1.7)		
Other, *n* (%)	1 (0.8)	1 (1.7)	0 (0.0)		
Race/Ethnicity				1.16	.28
White, *n* (%)	94 (79.0)	49 (83.1)	45 (75.0)		
Black or African American, *n* (%)	10 (8.4)	6 (10.2)	4 (6.7)		
Asian, *n* (%)	6 (5.0)	1 (1.7)	5 (8.3)		
American Indian or Alaska Native, *n* (%)	3 (2.5)	1 (1.7)	2 (3.3)		
Hispanic or Latinx, *n* (%)	2 (1.7)	0 (0.0)	2 (3.3)		
Middle Eastern, *n* (%)	1 (0.8)	1 (1.7)	0 (0.0)		
Mixed, *n* (%)	2 (1.7)	1 (1.7)	1 (1.7)		
Other, *n* (%)	1 (0.8)	0 (0.0)	1 (1.7)		
Relationship status				0.10	.76
Married, *n* (%)	45 (37.8)	23 (39.0)	22 (36.7)		
Engaged, *n* (%)	6 (5.0)	3 (5.1)	3 (5.0)		
In a relationship, *n* (%)	24 (20.2)	12 (20.3)	12 (20.0)		
Divorced/separated, *n* (%)	10 (8.4)	3 (5.1)	7 (11.7)		
Widowed, *n* (%)	1 (0.8)	0 (0.0)	1 (1.7)		
Never married, *n* (%)	33 (27.7)	18 (30.5)	15 (25.0)		
Employment status				5.52	.06
Employed (full- or part-time), *n* (%)	54 (45.4)	33 (55.9)	21 (35.0)		
Student, *n* (%)	25 (21.0)	11 (18.6)	14 (23.3)		
Not employed (e.g., disability, retired), *n* (%)	40 (33.6)	15 (25.4)	25 (41.7)		
Health insurance, *n* (%)	112 (94.1)	54 (91.5)	58 (96.7)	1.42	.23
Transportation, *n* (%)	115 (96.6)	57 (96.6)	58 (96.7)	0.00	.99

Note: All tests were two-tailed. Chi-square test for gender compared Women with all other genders combined. Chi-square test for race/ethnicity compared White with all other races/ethnicities combined. Chi-square test for relationship status compared Partnered (married, engaged, in a relationship) with all others combined.

Table 4: *Comparison of Conditions on Pain-Related Variables at Baseline*

Variable	Full sample (*N* = 119)	Exp. condition (*n* = 59)	Ctrl. condition (*n* = 60)	t/χ^2	*p*
Length of chronic pain in years, *M (SD)*	9.72 (8.51)	8.65 (6.99)	10.78 (9.72)	1.37	.17
Chronic primary pain, *n* (%)	97 (81.5)	51 (86.4)	46 (76.7)	1.89	.17
Headaches/migraines, *n* (%)	67 (56.3)	35 (59.3)	32 (53.3)		
Chronic back pain, *n* (%)	64 (53.8)	30 (50.8)	34 (56.7)		
Fibromyalgia, *n* (%)	37 (31.1)	22 (37.3)	15 (25.0)		
Temporomandibular disorders, *n* (%)	21 (17.6)	10 (16.9)	11 (18.3)		
Myofascial pain, *n* (%)	14 (11.8)	10 (16.9)	4 (6.7)		
Bladder pain, *n* (%)	12 (10.1)	8 (13.6)	4 (6.7)		
Complex regional pain syndrome, *n* (%)	5 (4.2)	2 (3.4)	3 (5.0)		
Chronic neuropathic pain, *n* (%)	42 (35.3)	19 (32.2)	23 (38.3)	0.49	.48
Sciatica, *n* (%)	27 (22.7)	13 (22.0)	14 (23.3)		
Carpal tunnel syndrome, *n* (%)	22 (18.5)	11 (18.6)	11 (18.3)		
Multiple sclerosis, *n* (%)	2 (1.7)	1 (1.7)	1 (1.7)		
Phantom limb pain, *n* (%)	1 (0.8)	1 (1.7)	0 (0.0)		
Chronic secondary musculoskeletal pain, *n* (%)	35 (29.4)	15 (25.4)	20 (33.3)	0.90	.34
Osteoarthritis (degenerative arthritis), *n* (%)	23 (19.3)	10 (16.9)	13 (21.7)		
Rheumatoid arthritis, *n* (%)	10 (8.4)	2 (3.4)	8 (13.3)		
Systemic lupus erythematosus, *n* (%)	6 (5.0)	3 (5.1)	3 (5.0)		
Chronic secondary visceral pain, *n* (%)	31 (26.1)	17 (28.8)	14 (23.3)	0.46	.50
Endometriosis, *n* (%)	23 (19.3)	14 (23.7)	9 (15.0)		
Inflammatory bowel disease, *n* (%)	11 (9.2)	5 (8.5)	6 (10.0)		
Chronic postsurgical/posttraumatic pain, *n* (%)	23 (19.3)	14 (23.7)	9 (15.0)	1.45	.23
Whiplash, *n* (%)	21 (17.6)	14 (23.7)	7 (11.7)		
Post-concussion syndrome, *n* (%)	6 (5.0)	2 (3.4)	4 (6.7)		
Chronic pain treatment					
Medication, *n* (%)	103 (86.6)	46 (78.0)	57 (95.0)	6.54	**.01***
Physical therapy, *n* (%)	32 (26.9)	19 (32.2)	13 (21.7)	1.68	.20
Psychotherapy, *n* (%)	29 (24.4)	13 (22.0)	16 (26.7)	0.35	.56
Yoga/Tai Chi, *n* (%)	32 (26.9)	18 (30.5)	14 (23.3)	0.78	.38
Acupuncture, *n* (%)	4 (3.4)	3 (5.1)	1 (1.7)	1.11	.29
Massage therapy, *n* (%)	24 (20.2)	15 (25.4)	9 (15.0)	2.01	.16
Member of chronic pain Facebook group, *n* (%)	27 (22.7)	15 (25.4)	12 (20.0)	0.50	.48

Note: All tests were two-tailed. Chi-square tests for chronic primary pain, chronic neuropathic pain, chronic secondary musculoskeletal pain, chronic secondary visceral pain, and chronic postsurgical/posttraumatic pain compared the presence with the absence of each pain category (e.g., those who had chronic primary pain versus those who did not).

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; the p-values are bold when they are less than the significance level cut-off of .05.

Table 5: *Comparison of Conditions on Predictor and Outcome Measures at Baseline*

Predictor or outcome measure	Full sample (*N* = 119)	Exp. condition (*n* = 59)	Ctrl. condition (*n* = 60)	*t*	*p*
Perceived social constraints, *M (SD)*	37.29 (11.50)	35.85 (12.30)	38.72 (10.57)	1.37	.18
Ambivalence over emotional expression, *M (SD)*	3.02 (0.93)	2.87 (0.91)	3.17 (0.93)	1.79	.08
Pain severity, *M (SD)*	4.61 (1.57)	4.41 (1.57)	4.81 (1.55)	1.40	.16
Pain interference, *M (SD)*	5.41 (2.35)	4.95 (2.51)	5.86 (2.11)	2.14	**.03***
Depression, *M (SD)*	2.79 (1.09)	2.66 (1.06)	2.91 (1.11)	1.27	.21
Anxiety, *M (SD)*	2.89 (0.99)	2.69 (1.02)	3.08 (0.93)	2.16	**.03***

Note: All tests were two-tailed.
$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; the p-values are bold when they are less than the significance level cut-off of .05.

Pearson correlations among all key variables at each time point were calculated using the overall sample for descriptive purposes and to examine the relationships among variables (see Table 6). The two predictor variables (perceived social constraints and ambivalence over emotional expression) were strongly positively correlated with each other and were positively related to the outcomes of interest at baseline, post-intervention, and 1-month follow-up. Perceived social constraints had small correlations with pain severity, moderate correlations with pain interference, and moderate to large correlations with depression and anxiety. Ambivalence over emotional expression similarly had moderate to large correlations with depression and anxiety but was generally not significantly related to the pain variables.

Unsurprisingly, the four outcome variables were positively related to each other at each of the three time points. The correlations between pain variables were moderate to large, as were the correlations between depression and anxiety. The pain variables had small to moderate correlations with depression and anxiety, with pain interference having overall larger correlation coefficients than pain severity.

Table 6: *Correlations among Predictor and Outcome Measures at Baseline, Post-Intervention, and 1-Month Follow-Up in the Overall Sample*

Predictor and outcome measures	GSC –BL	AEQ –BL	Pain sev –BL	Pain sev –Post	Pain sev –F/U	Pain int –BL	Pain int –Post	Pain int –F/U	Dep –BL	Dep –Post	Dep –F/U	Anx –BL	Anx –Post
Predictor measures													
GSC–BL	-												
AEQ–BL	**.56*****	-											
Outcome measures													
Pain severity–BL	**.22***	.12	-										
Pain severity–Post	**.20***	.11	**.64*****	-									
Pain severity–F/U	**.21***	.16	**.61*****	**.82*****	-								
Pain interference–BL	**.42*****	**.23***	**.53*****	**.42*****	**.38*****	-							
Pain interference–Post	**.34*****	.17	**.46*****	**.69*****	**.55*****	**.68*****	-						
Pain interference–F/U	**.34*****	.17	**.46*****	**.57*****	**.68*****	**.67*****	**.75*****	-					
Depression–BL	**.45*****	**.40*****	**.27****	**.28****	**.21***	**.55*****	**.39*****	**.33*****	-				
Depression–Post	**.42*****	**.39*****	**.20***	**.31*****	**.23***	**.46*****	**.40*****	**.35*****	**.76*****	-			
Depression–F/U	**.42*****	**.36*****	**.34*****	**.39*****	**.39*****	**.48*****	**.42*****	**.50*****	**.77*****	**.79*****	-		
Anxiety–BL	**.52*****	**.60*****	**.30*****	**.26****	**.19***	**.47*****	**.28****	**.28****	**.73*****	**.59*****	**.63*****	-	
Anxiety–Post	**.49*****	**.53*****	.15	**.26****	.18	**.40*****	**.32*****	**.31*****	**.62*****	**.76*****	**.63*****	**.75*****	-
Anxiety–F/U	**.43*****	**.41*****	**.27****	**.30****	**.24****	**.41*****	**.34*****	**.41*****	**.63*****	**.57*****	**.75*****	**.69*****	**.69*****

Note: GSC = General Social Constraints Scale (perceived social constraints); AEQ = Ambivalence over Emotional Expressiveness Questionnaire (ambivalence over emotional expression); BL = baseline variable; Post = post-intervention variable; F/U = 1-month follow-up variable.
$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$; the correlations are bold when they are less than the significance level cut-off of .05.

Finally, independent samples t-tests and chi-square tests of independence tested whether participants in the experimental and control conditions differed in engagement with their respective Facebook groups (see Table 7). Experimental and control participants did not significantly differ in self-reported use or number of posts and comments. On average, participants reported visiting the Facebook group more than 5 days per week, or 21 days out of the total 28 days. Each participant posted to the Facebook group between 0 and 15 times during the 28-day period, with an average of 2.49 (*SD* = 2.42) posts per person. Participants commented on others' posts between 0 and 58 times (*M* = 10.34, *SD* = 11.35). There was a weak negative correlation

between frequency of use and anxiety at post-intervention (r = -.19, p = .047), such that greater use of the Facebook groups was related to lower anxiety. Frequency of use was not related to anxiety at baseline (r = -.05, p = .567) or 1-month follow-up (r = -.01, p = .912). The measures of engagement were not significantly associated with any of the other predictor or outcome measures at any other time point.

Table 7: *Comparison of Conditions on Facebook Group Engagement*

Measure of engagement	**Full sample (N = 119)**	**Exp. condition (n = 59)**	**Ctrl. condition (n = 60)**	t/χ^2	p
Average frequency of use per week[1], *M (SD)*	5.28 (1.53)	5.20 (1.51)	5.36 (1.56)	0.57	.57
Total frequency of use[2], *M (SD)*	21.14 (6.13)	20.81 (6.04)	21.46 (6.26)	0.57	.57
Number of posts per person[3]					
M (SD)	2.49 (2.42)	2.69 (2.96)	2.28 (1.73)	-0.93	.36
Minimum – Maximum	0 – 15	0 – 15	0 – 7		
Number of comments per person[3]					
M (SD)	10.34 (11.35)	11.61 (13.24)	9.10 (9.05)	-1.21	.23
Minimum – Maximum	0 – 58	0 – 58	0 – 34		
Active User, Lurker, or Non-user				0.64	.43
Active User, *n* (%)	51 (42.9)	22 (37.3)	29 (48.3)		
Lurker, *n* (%)	53 (44.5)	27 (45.8)	26 (43.3)		
Non-user, *n* (%)	4 (3.4)	2 (3.4)	2 (3.3)		
Missing, *n* (%)	11 (9.2)	8 (13.6)	3 (5.0)		

Note: All tests were two-tailed. Chi-square test for "Active User, Lurker, or Non-user" compared Active Users with Lurkers only. [1]Out of 7 days. [2]Out of 28 days. [3]Objective measure.

Participants additionally reported whether they considered themselves to be Lurkers or Active Users. Consistent with the definition of a lurker, participants who classified themselves as Lurkers did not differ from Active Users in self-reported frequency of use (t(102) = 1.93, p = .056), but had significantly fewer objectively-counted posts (t(102) = 4.24, p < .001) and comments (t(102) = 3.96, p < .001) than Active Users. There were approximately equal numbers of Active Users and Lurkers in this study, with no differences between conditions.

Among those who completed 1-month follow-up, 20 participants (19.6%) in the overall sample reported that they contacted member(s) of the Facebook group after the intervention ended, and 32 participants (31.4%) reported joining another Facebook group for chronic pain. Experimental and control conditions did not differ in number of participants who contacted Facebook group members ($\chi^2(1) = 0.50$, $p = .481$) or joined another Facebook group ($\chi^2(1) = 0.78$, $p = .379$).

Aim 1: Impact of Facebook-Based Support Groups on Adults with Chronic Pain

Table 8 presents the means and standard deviations for each outcome measure by condition at baseline, post-intervention, and 1-month follow-up, the baseline-adjusted means and standard errors at post-intervention and 1-month follow-up, and the results of the ANCOVAs comparing conditions. Also presented in Table 8 are the effect sizes for within- and between-condition comparisons. Mean ratings for each outcome at baseline, post-intervention, and 1-month follow-up by condition are depicted graphically in Figure 2.

Post-intervention outcomes. Mixed design ANOVAs showed no significant group differences (condition x time interaction effects) in pain severity ($F(1,117) = 0.01$, $p = .907$, $\eta_p^2 = .00$), pain interference ($F(1,117) = 0.69$, $p = .407$, $\eta_p^2 = .01$), or depression ($F(1,117) = 1.98$, $p = .162$, $\eta_p^2 = .02$). There were significant main effects of time, such that participants across conditions showed improvements from baseline to post-intervention in pain severity ($F(1,117) = 5.84$, $p = .017$, $\eta_p^2 = .05$, medium effect), pain interference ($F(1,117) = 21.17$, $p < .001$, $\eta_p^2 = .15$, large effect), and depression ($F(1,117) = 4.78$, $p = .031$, $\eta_p^2 = .04$, small to medium effect). Similarly, the results of ANCOVAs controlling for baseline levels of outcome measures indicated no significant differences between conditions at post-intervention in pain severity, pain interference, or depression (see Table 8). Though experimental and control participants did not

differ significantly in change in anxiety from baseline to post-intervention, the condition x time interaction effect was small to medium ($F(1,117) = 3.16$, $p = .078$, $\eta_p^2 = .03$), such that controls had a slightly greater improvement in anxiety score compared to experimental participants. Similarly, paired sample t-tests showed a significant reduction in anxiety in the control condition (small effect), whereas there was not a significant reduction in anxiety in the experimental condition. Notably, control participants had significantly greater anxiety scores at baseline compared to experimental participants (see Table 5), and when controlling for baseline levels of anxiety, experimental conditions did not differ in average anxiety at post-intervention (see Table 8).

1-month follow-up outcomes. Longer-term (1-month follow-up) outcomes showed similar patterns. Mixed design ANOVAs showed no significant group differences (condition X time interaction effects) from baseline to 1-month follow-up in pain severity ($F(1,117) = 0.11$, $p = .740$, $\eta_p^2 = .00$), pain interference ($F(1,117) = 0.14$, $p = .713$, $\eta_p^2 = .00$), or depression ($F(1,117) = 1.53$, $p = .219$, $\eta_p^2 = .01$). There were significant main effects of time, such that participants across conditions showed reductions from baseline to 1-month follow-up in pain severity ($F(1,117) = 14.28$, $p < .001$, $\eta_p^2 = .11$, medium to large effect), pain interference ($F(1,117) = 45.96$, $p < .001$, $\eta_p^2 = .28$, large effect), and depression ($F(1,117) = 11.78$, $p < .001$, $\eta_p^2 = .09$, medium to large effect). Similarly, the results of ANCOVAs controlling for baseline levels of outcome measures indicated no significant differences between conditions at 1-month follow-up in pain severity, pain interference, and depression (see Table 8). There was a significant condition x time interaction effect from baseline to 1-month follow-up for anxiety ($F(1,117) = 4.36$, $p = .039$, $\eta_p^2 = .04$, small to medium effect), such that controls showed a greater improvement in anxiety score compared to experimental participants. Paired sample t-tests showed a significant reduction in anxiety in the

control condition (small effect) versus nonsignificant change in the experimental condition. Yet, when controlling for baseline levels of anxiety, the ANCOVA showed that the experimental condition did not differ from controls in anxiety at 1-month follow-up (see Table 8).

Mixed design ANOVAs and t-tests were used to compare outcomes at post-intervention with 1-month follow-up to determine whether participants retained their outcomes one month after the intervention ended. There were no significant group differences (condition x time interaction effects) from post-intervention to 1-month follow-up in any of the outcomes (*p*s > .05). There was a significant main effect of time for pain interference, such that participants across conditions showed reductions in pain interference from post-intervention to 1-month follow-up, $F(1,117) = 6.20$, $p = .014$, $\eta_p^2 = .05$, a medium effect size. Paired sample t-tests suggest that this reduction in pain interference may have been driven by the experimental condition. T-tests showed that, within experimental participants but not controls, pain interference continued to decrease one month later, with average pain interference scores at 1-month follow-up ($M = 3.70$, $SD = 2.51$) significantly lower than at post-intervention ($M = 4.29$, $SD = 2.34$), $t(58) = 2.56$, $p = 0.013$, $d = 0.33$. For the remaining outcomes—pain severity, depression, and anxiety—paired sample t-tests indicated that participants' outcomes at 1-month follow-up were similar to post-intervention (*p*s > 0.05) for both experimental and control participants.

Table 8: *Comparison of Conditions on Outcomes from Baseline to Post-Intervention and 1-Month Follow-Up, Between-Condition Analyses of Covariance, and Both Within- and Between-Condition Effect Sizes*

Measure	Timepoint	Exp. Condition (*n* = 59)	*d* within	Ctrl. Condition (*n* = 60)	*d* within	*F*	*p*	η_p^2
Pain severity	Baseline, *M (SD)*	4.41 (1.57)		4.81 (1.55)				
	Post, *M (SD)*	4.11 (1.79)		4.48 (1.77)				
	Post adj., *M (SE)*	4.26 (0.18)		4.33 (0.18)		0.10	.757	0.00
	Post change, *M (SD)*	-0.30 (1.55)	-0.20	-0.33 (1.32)	-0.25			
	1-month, *M (SD)*	3.85 (1.68)		4.34 (1.84)				
	1-month adj., *M (SE)*	3.99 (0.18)		4.21 (0.18)		0.69	.408	0.01
	1-month change, *M (SD)*	-0.56 (1.62)	-0.35**	-0.47 (1.34)	-0.35**			
Pain interference	Baseline, *M (SD)*	4.95 (2.51)		5.86 (2.11)				
	Post, *M (SD)*	4.29 (2.34)		4.91 (2.39)				
	Post adj., *M (SE)*	4.60 (0.23)		4.60 (0.23)		0.00	.994	0.00
	Post change, *M (SD)*	-0.66 (1.95)	-0.34*	-0.95 (1.86)	-0.51***			
	1-month, *M (SD)*	3.70 (2.51)		4.73 (2.11)				
	1-month adj., *M (SE)*	4.00 (0.23)		4.44 (0.23)		1.81	.181	0.02
	1-month change, *M (SD)*	-1.25 (2.21)	-0.57***	-1.12 (1.56)	-0.72***			
Depression	Baseline, *M (SD)*	2.66 (1.06)		2.91 (1.11)				
	Post, *M (SD)*	2.61 (1.04)		2.68 (0.96)				
	Post adj., *M (SE)*	2.70 (0.09)		2.59 (0.08)		0.86	.355	0.01
	Post change, *M (SD)*	-0.05 (0.78)	-0.07	-0.24 (0.66)	-0.36**			
	1-month, *M (SD)*	2.52 (1.06)		2.61 (0.95)				
	1-month adj., *M (SE)*	2.61 (0.08)		2.52 (0.08)		0.56	.456	0.01
	1-month change, *M (SD)*	-0.14 (0.68)	-0.21	-0.30 (0.74)	-0.74**			
Anxiety	Baseline, *M (SD)*	2.69 (1.02)		3.08 (0.93)				
	Post, *M (SD)*	2.72 (0.93)		2.88 (0.90)				
	Post adj., *M (SE)*	2.85 (0.08)		2.75 (0.08)		0.85	.360	0.01
	Post change, *M (SD)*	0.03 (0.62)	0.04	-0.19 (0.72)	-0.27*			
	1-month, *M (SD)*	2.73 (0.89)		2.83 (0.86)				
	1-month adj., *M (SE)*	2.85 (0.08)		2.72 (0.08)		1.27	.263	0.01
	1-month change, *M (SD)*	0.04 (0.75)	0.05	-0.24 (0.72)	-0.34*			

Note: Post-intervention adj. *M* and 1-month follow-up adj. *M* are adjusted for the baseline value of the outcome measure. *d* within is the effect size of change from baseline to post-intervention and baseline to 1-month follow-up within each condition, and was calculated using Cohen's *d*. Between-condition effect sizes at post-intervention and 1-month follow-up were calculated using partial eta squared (η_p^2) using the adjusted means.
*$p < .05$; **$p < .01$; ***$p < .001$

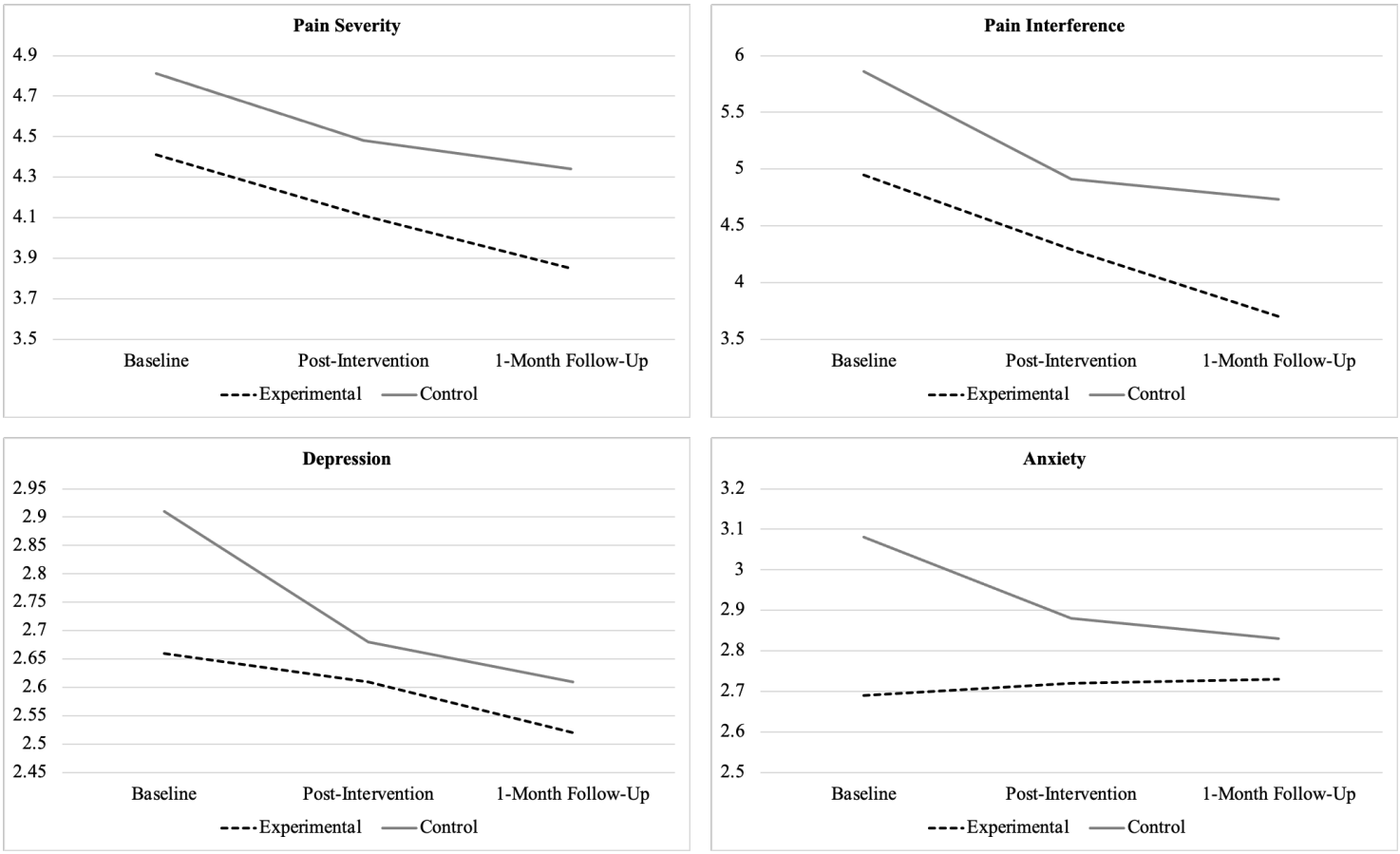

Figure 2: Mean ratings for each outcome at baseline, post-intervention, and 1-month follow-up by condition.

Aim 2: Moderators and/or Predictors of Outcomes

Baseline perceived social constraints and ambivalence over emotional expression. Table 9 shows how each of the two potential moderators is correlated with change in pain severity, pain interference, depression, and anxiety for experimental participants, controls, and the full sample. For all outcome variables, lower values of the change score indicate more improvement over time. Thus, a negative correlation in the table, for example, means that higher scores on the baseline moderator predict more improvement (lower scores) on the outcome measure.

Perceived social constraints. The correlations between baseline perceived social constraints and outcome change scores were mostly negative, suggesting that greater perceived

social constraints at baseline tended to predict greater improvement after engaging with the Facebook groups. However, only a few of these negative correlations were significant. First, greater perceived social constraints predicted greater reduction in pain interference at 1-month follow-up, but only for controls (r = -.30, p = .021), not experimental participants (r = .02, p = .888). Despite these discrepant correlations between control and experimental conditions, perceived social constraints did not significantly moderate the effects of experimental condition on pain interference, b = .05, $t(115)$ = 1.53, 95% CI [-.014, .109], p = .128. Second, higher perceived social constraints predicted greater reduction in depressive symptoms at 1-month follow-up, but, again, only for controls (r = -.29, p = .027), not experimental participants (r = .13, p = .317). In this case, perceived social constraints significantly moderated the effects of experimental condition on depressive symptoms at 1-month follow-up, b = .03, $t(115)$ = 2.40, 95% CI [.005, .050], p = .018 (see Figure 3). Third, greater perceived social constraints significantly predicted greater improvement in anxiety at 1-month follow-up across conditions (b = -.01, $t(117)$ = -2.06, 95% CI [-.024, .000], p = .042. Perceived social constraints neither moderated nor predicted any other outcome change scores at post-intervention or 1-month follow-up.

Ambivalence over emotional expression. Across conditions, greater ambivalence over emotional expression at baseline predicted greater reductions in anxiety at 1-month follow-up, b = -.26, $t(117)$ = -3.69, 95% CI [-.399, -.120], p <.001. This relationship may have been largely driven by the experimental condition, which showed a stronger relationship between ambivalence over emotional expression and improved anxiety symptoms (r = -.39, p = .003) compared to controls (r = -.22, p = .097). However, ambivalence over emotional expression did not significantly moderate the effects of experimental condition on anxiety, or on any of the other outcomes, at post-

intervention or 1-month follow-up. Correlations within each experimental condition were often near zero, and no other correlations were significant.

Table 9: *Correlations of Baseline Perceived Social Constraints and Ambivalence over Emotional Expression with Changes in Outcome Measures for Each Condition*

	Full sample (*N* = 119)	**Exp. condition (*n* = 59)**	**Ctrl. condition (*n* = 60)**	**Significant condition differences**
Perceived social constraints				
Pain severity				
Post-intervention	.01	-.08	.13	No
1-month follow-up	.02	-.05	.10	No
Pain interference				
Post-intervention	-.09	-.08	-.08	No
1-month follow-up	-.10	.02	-.30*	No
Depression				
Post-intervention	-.08	-.02	-.14	No
1-month follow-up	-.08	.13	-.29*	Yes*
Anxiety				
Post-intervention	-.10	-.06	-.10	No
1-month follow-up	-.19*	-.18	-.15	No
Ambivalence over emotional expression				
Pain severity				
Post-intervention	.02	.03	.002	No
1-month follow-up	.06	.06	.05	No
Pain interference				
Post-intervention	-.08	-.03	-.11	No
1-month follow-up	-.08	-.08	-.10	No
Depression				
Post-intervention	-.07	-.10	-.003	No
1-month follow-up	-.10	.001	-.16	No
Anxiety				
Post-intervention	-.16	-.19	-.09	No
1-month follow-up	-.32***	-.39**	-.22	No

Note: Each potential moderator variable was correlated with change scores (post-intervention or 1-month follow-up minus baseline). Lower values of all change scores indicate more improvement.
*$p < .05$; **$p < .01$; ***$p < .001$

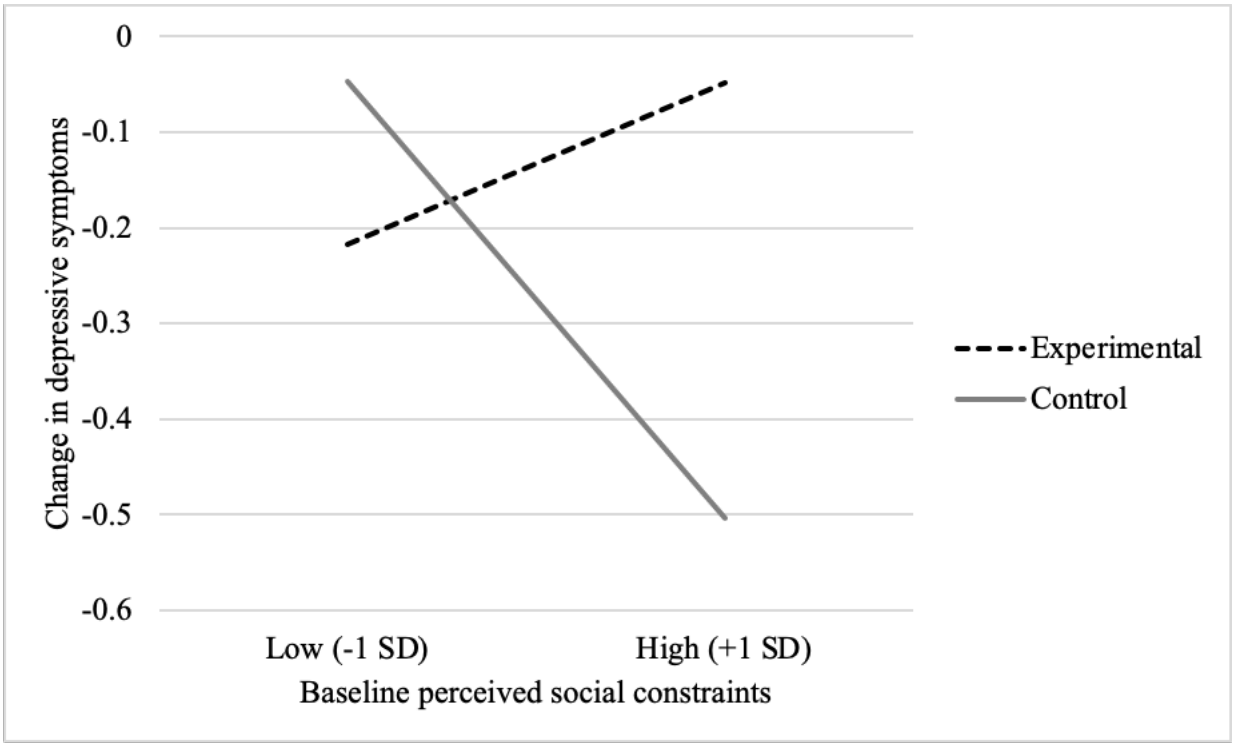

Figure 3: Baseline perceived social constraints moderate the effects of experimental condition on depressive symptoms at 1-month follow-up.

Type of chronic pain condition and Facebook group engagement. Table 10 shows comparisons on outcome change scores between participants with chronic primary pain versus other pain conditions and between participants who identified as Lurkers versus Active Users within the full sample, experimental condition, and control condition. For all outcome variables, lower values of the change score indicate more improvement over time.

Type of chronic pain condition. In the total sample, participants with a primary pain condition showed overall greater improvements in outcomes compared to those with other pain conditions. Notably, across conditions, those with primary pain had significantly greater pain severity at baseline (M = 4.84, SD = 1.56) than participants with other pain conditions (M = 3.64, SD = 1.19; $t(117)$ = -3.38, $p < .001$, d = -.80) and therefore, had greater opportunity to improve. And within the experimental condition, participants with chronic primary pain had significantly

greater pain interference at baseline (M = 5.23, SD = 2.54) compared to those with other pain conditions (M = 3.14, SD = 1.31), $t(57)$ = -2.27, p = .027, d = -.86. Participants with chronic primary pain did not significantly differ from those with other pain conditions in baseline levels of depression or anxiety in either experimental condition. Type of chronic pain condition significantly predicted changes in anxiety at post-intervention ($F(1,117)$ = 5.73, p = .018, η_p^2 = .05, a medium effect size); those with primary pain showed significant reductions in anxiety ($t(96)$ = 2.25, p = .027, d = .23), whereas participants with other pain conditions showing nonsignificant increases in anxiety ($t(21)$ = -1.72, p = .100, d = -.37). Though there were no significant condition x time x moderator interaction effects for any of the outcomes, the effects of pain condition on outcomes may have been driven by the experimental condition. Among experimental participants, having primary pain was related to greater reductions in pain severity at post intervention and 1-month follow-up (medium effect sizes), pain interference at post-intervention and 1-month follow-up (medium effect sizes), and anxiety at post-intervention (medium to large effect size), although effects were nonsignificant. In contrast, among controls, the relationship between pain condition and changes in outcomes was weaker and inconsistent. In the control condition, those with primary pain conditions showed significantly greater improvements in anxiety symptoms at post-intervention than those with other pain conditions ($t(58)$ = 2.03, p = .047, d = .62) and moderately greater improvements in depressive symptoms at post-intervention ($t(58)$ = 1.46, p = .149, d = .45). Otherwise, control participants with primary pain conditions looked similar to, or worse than, those with other types of pain conditions after participating in the control condition.

Facebook group engagement. Engagement (Lurker versus Active User) did not significantly moderate or predict outcomes at post-intervention or 1-month follow-up (ps > .05). In the overall sample, Lurkers showed somewhat greater improvements than Active Users on all

outcomes, though effect sizes were small and nonsignificant. The relationship between engagement and outcomes appeared to be stronger in the experimental condition compared to the control. Within the experimental condition, Lurkers showed significantly greater reductions in pain interference from baseline to 1-month follow-up compared to Active Users ($t(47) = 2.04$, $p = .047$, $d = .59$, medium effect), whereas Lurkers and Active Users had similar outcomes in the control condition ($p = .802$, $d = -.07$). Though engagement did not significantly moderate the effects of experimental condition on pain interference, there was a small to medium condition x time x moderator interaction effect, $F(1,100) = 3.63$, $p = .059$, $\eta_p^2 = .04$. Notably, within the experimental condition only, Lurkers had significantly greater pain interference at baseline ($M = 5.83$, $SD = 2.23$) compared to Active Users ($M = 4.17$, $SD = 2.64$), $t(47) = -2.39$, $p = .021$, $d = -.69$, and therefore, had more opportunity for improvement. Lurkers and Active Users did not otherwise differ in baseline levels of outcome measures in either experimental condition. The relationship between engagement and anxiety varied somewhat by condition. In the experimental condition, Lurkers had moderately greater reductions in anxiety compared to Active Users at post-intervention ($d = .37$) and 1-month follow-up ($d = .50$), and in fact, Active Users, on average, showed increases in anxiety at post-intervention and 1-month follow-up. This pattern was not observed in the control condition; both Lurkers and Active Users showed similar reductions in anxiety symptoms at post-intervention ($d = -.03$) and at 1-month follow-up ($d = .18$).

Table 10: *Comparison of Active Users vs. Lurkers and Participants with Chronic Primary Pain vs. Other Pain Conditions on Outcome Change Scores for each Condition*

	Engagement			**Pain Condition**		
	Active User (*n* = 51)	**Lurker (*n* = 53)**	***d***	**Primary Pain (*n* = 97)**	**Other (*n* = 22)**	***d***
Full Sample						
Pain severity						
Post-intervention, *M (SD)*	-0.27 (1.25)	-0.41 (1.59)	.10	-0.39 (1.43)	-0.02 (1.44)	.26
1-month follow-up, *M (SD)*	-0.38 (1.21)	-0.63 (1.81)	.17	-0.55 (1.46)	-0.34 (1.57)	.14
Pain interference						
Post-intervention, *M (SD)*	-0.63 (1.97)	-1.12 (1.87)	.25	-0.82 (1.85)	-0.73 (2.17)	.05
1-month follow-up, *M (SD)*	-0.88 (1.88)	-1.48 (2.05)	.30	-1.22 (1.87)	-1.04 (2.07)	.09
Depression						
Post-intervention, *M (SD)*	-0.08 (0.72)	-0.21 (0.80)	.18	-0.17 (0.75)	-0.03 (0.58)	.19
1-month follow-up, *M (SD)*	-0.11 (0.77)	-0.32 (0.69)	.29	-0.21 (0.69)	-0.31 (0.82)	-.14
Anxiety						
Post-intervention, *M (SD)*	-0.05 (0.62)	-0.13 (0.74)	.12	-0.15 (0.68)	0.22 (0.60)	.57*
1-month follow-up, *M (SD)*	0.04 (0.76)	-0.20 (0.80)	.30	-0.10 (0.78)	-0.15 (0.68)	-.01
	Active User (*n* = 22)	**Lurker (*n* = 27)**	***d***	**Primary Pain (*n* = 51)**	**Other (*n* = 8)**	***d***
Experimental Condition						
Pain severity						
Post-intervention, *M (SD)*	-0.32 (1.62)	-0.46 (1.45)	.10	-0.39 (1.52)	0.25 (1.72)	.42
1-month follow-up, *M (SD)*	-0.30 (1.31)	-0.83 (1.99)	.31	-0.68 (1.58)	0.19 (1.78)	.54
Pain interference						
Post-intervention, *M (SD)*	-0.34 (1.98)	-1.16 (1.93)	.42	-0.77 (2.03)	0.06 (1.22)	.43
1-month follow-up, *M (SD)*	-0.56 (1.82)	-1.92 (2.65)	.59*	-1.41 (2.30)	-0.23 (1.15)	.54
Depression						
Post-intervention, *M (SD)*	-0.01 (0.85)	-0.08 (0.85)	.09	-0.05 (0.80)	-0.06 (0.66)	-.02
1-month follow-up, *M (SD)*	-0.04 (0.77)	-0.21 (0.72)	.23	-0.16 (0.68)	-0.06 (0.78)	.14
Anxiety						
Post-intervention, *M (SD)*	0.18 (0.61)	-0.06 (0.70)	.37	-0.03 (0.61)	0.37 (0.61)	.64
1-month follow-up, *M (SD)*	0.30 (0.72)	-0.09 (0.84)	.50	0.03 (0.80)	0.11 (0.30)	.11
	Active User (*n* = 29)	**Lurker (*n* = 26)**	***d***	**Primary Pain (*n* = 46)**	**Other (*n* = 14)**	***d***
Control Condition						
Pain severity						
Post-intervention, *M (SD)*	-0.23 (0.90)	-0.35 (1.74)	.09	-0.38 (1.33)	-0.17 (1.31)	.16

1-month follow-up, *M (SD)*	-0.44 (1.14)	-0.44 (1.62)	.00	-.041 (1.33)	-0.65 (1.41)	-.17
Pain interference						
Post-intervention*, M (SD)*	-0.85 (1.98)	-1.08 (1.84)	.12	-0.88 (1.65)	-1.18 (2.48)	-.16
1-month follow-up, *M (SD)*	-1.13 (1.91)	-1.01 (0.98)	-.07	-1.01 (1.23)	-1.51 (2.36)	-.32
Depression						
Post-intervention*, M (SD)*	-0.13 (0.62)	-0.36 (0.74)	.33	-0.30 (0.68)	-0.02 (0.55)	.45
1-month follow-up, *M (SD)*	-0.16 (0.78)	-0.43 (0.66)	.37	-0.26 (0.71)	-0.45 (0.84)	-.25
Anxiety						
Post-intervention*, M (SD)*	-0.23 (0.58)	-0.21 (0.78)	-.03	-0.29 (0.72)	0.14 (0.60)	.62*
1-month follow-up, *M (SD)*	-0.17 (0.74)	-0.30 (0.76)	.18	-0.25 (0.74)	-0.23 (0.68)	.02

Note: Levels of each moderator variable are compared on average change score (post-intervention or 1-month follow-up minus baseline) using t-tests within the full sample, experimental condition, and control condition. Lower values of all change scores indicate more improvement. *d* is the effect size of the difference in outcomes between Active Users and Lurkers or those with chronic primary pain and other pain conditions, and was calculated using Cohen's d.
$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Exploratory Analyses

Experimental and control participants rated their satisfaction with various aspects of the Facebook groups on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*), with higher ratings typically indicating greater satisfaction. Table 11 presents mean ratings and standard deviations, by condition, for each item, as well as the results of t-tests comparing conditions on their satisfaction ratings. Also presented in Table 11 are the results of chi-square tests comparing conditions on the number of participants who agreed with each item (rating of 5-7), neither agreed nor disagreed (rating of 4), and disagreed (rating of 1-3).

T- and chi-sqaure tests showed no significant condition differences in satisfaction. Across conditions, the majority of participants (82.4%) were satisfied with their group experience, and 85.2% would recommend the Facebook group to other people with chronic pain. Nearly all participants (98.1%) agreed that the Facebook group was easy to use, and 77.8% appreciated the online (vs. in-person) format. Most participants (83.3%) found the Facebook group helpful, and slightly over half (51.9%) reported that other group members introduced them to new ways of

managing pain. Very few participants (5.6%) endorsed feeling pressured by group members to change things they were uncomfortable with. Similarly, only 3 participants (2.5%) reported an "invasion of privacy." Specifically, one of the participants desired a more anonymous interface that did not reveal participants' names, given that group members shared a lot of personal information. The other two participants described issues related to the heterogeneity of gender and pain condition within the group. A female participant felt uncomfortable discussing her primary pain condition (vulvodynia) with males present. A male participant felt outnumbered by females, noting differences in the pain experience "on the basis of prototypical gender;" this participant also felt that it was burdensome to explain his pain condition to other participants with varying pain diagnoses. No other adverse experiences were described or reported to the researchers.

Table 11: *Comparison of Conditions on Acceptability Items: Satisfaction with Facebook Groups*

Acceptability Item	Exp. condition (*n* = 51)	Ctrl. condition (*n* = 57)	*t/χ2*	*p*
Satisfied with my group experience				
M (SD)	5.49 (1.39)	5.63 (1.26)	0.55	.581
n (%) agree	40 (78.4)	49 (86.0)	2.30	.317
Would recommend this group				
M (SD)	5.55 (1.36)	5.74 (1.32)	0.73	.468
n (%) agree	43 (84.3)	49 (86.0)	0.31	.855
Liked that group was online vs. in-person				
M (SD)	5.73 (1.42)	5.60 (1.65)	-0.43	.665
n (%) agree	40 (78.4)	44 (77.2)	0.26	.879
Overall, group was helpful				
M (SD)	5.37 (1.41)	5.54 (1.51)	0.69	.489
n (%) agree	41 (80.4)	49 (86.0)	0.61	.736
Facebook group was easy to use				
M (SD)	6.27 (.75)	6.46 (.73)	1.27	.207
n (%) agree	50 (98.0)	56 (98.2)	2.01	.366
Group members introduced me to new ways of managing my pain				
M (SD)	4.29 (1.87)	4.07 (1.72)	-0.65	.518
n (%) agree	28 (54.9)	28 (49.1)	0.46	.797
Group members pressured me to change things I was uncomfortable with				
M (SD)	2.25 (1.57)	1.95 (1.37)	-1.09	.280
n (%) agree	3 (5.9)	3 (5.3)	0.30	.863

Note: All tests were two-tailed. T-tests compared conditions on mean ratings for each item, with ratings ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), with higher ratings typically indicating greater satisfaction. Chi-square tests compared conditions on number of participants who agreed with each item (rating of 5-7), neither agreed nor disagreed (rating of 4), and disagreed (rating of 1-3).

Experimental and control participants also rated their preferences regarding various aspects of the Facebook groups on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*), with higher ratings indicating stronger preference for the item. Table 12 presents mean ratings and standard deviations, by condition, for each item, as well as the results of t-tests comparing conditions on

their ratings. Also presented in Table 12 are the results of chi-square tests comparing conditions on the number of participants who agreed with each item (rating of 5-7), neither agreed nor disagreed (rating of 4), and disagreed (rating of 1-3). Across conditions, most participants (85.2%) would have preferred that the group extend longer than 1 month and would have liked to learn more strategies for dealing with pain. Over one third of participants (38.9%) would have preferred a Facebook group with more members than the 28- to 32-member Facebook groups used for this study, whereas 33.3% were ambivalent and 27.8% preferred the group size as it was. Only 9.3% would have preferred a group with fewer members. Over half of the participants (54.6%) favored a group in which everyone has the same type of chronic pain condition (e.g., fibromyalgia, chronic back pain).

The results of t- and chi-square tests showed that experimental and control participants had differential preferences regarding the engagement and role of clinician facilitators. Controls appeared to be more ambivalent than experimental participants about the presence of clinician facilitators in the Facebook group, with 40.5% of controls preferring a group run by clinicians, 10.5% preferring a group with only chronic pain experiencers, and about half (49.0%) not caring either way. Compared to the 10.5% of controls, 23.5% of experimental participants would have preferred a group with only chronic pain members; over half (53.0%) of experimental participants favored a group run by clinicians and 23.5% had no preference. Experimental conditions also differed in their preferences regarding the extent of clinician engagement. Compared to controls', experimental participants' mean rating indicated a stronger desire for clinician facilitators to comment on their posts in the Facebook group ($d = 0.41$, a small to medium effect size).

Table 12: *Comparison of Conditions on Acceptability Items: Preferences*

Acceptability Item	Exp. condition (*n* = 51)	Ctrl. condition (*n* = 57)	*t*/$\chi 2$	*p*
Wish this group was longer than 1 month				
M (SD)	5.76 (1.51)	5.84 (1.29)	0.29	.774
n (%) agree	42 (82.4)	50 (87.7)	0.87	.649
Prefer a Facebook group not run by clinicians, only people with pain				
M (SD)	3.35 (1.72)	3.40 (1.41)	0.17	.869
n (%) agree	12 (23.5)	6 (10.5)	8.41	.015*
Prefer a group with more people				
M (SD)	4.24 (1.61)	4.23 (1.64)	-0.02	.982
n (%) agree	20 (39.2)	22 (38.6)	0.90	.638
Prefer a group with less people				
M (SD)	3.08 (1.59)	2.84 (1.36)	-0.83	.406
n (%) agree	7 (13.7)	3 (5.3)	2.42	.299
Would have liked the clinical researchers to comment on my posts				
M (SD)	5.08 (1.50)	4.42 (1.69)	-2.13	.035*
n (%) agree	27 (52.9)	25 (43.9)	3.04	.218
Would have liked to learn more strategies for dealing with pain				
M (SD)	5.61 (1.27)	5.67 (1.22)	0.25	.806
n (%) agree	44 (86.3)	48 (84.2)	0.10	.954
Prefer a group in which everyone has the same kind of pain (e.g., fibromyalgia)				
M (SD)	4.71 (1.88)	4.25 (1.96)	-1.24	.217
n (%) agree	31 (60.8)	28 (49.1)	1.56	.459

Note: All tests were two-tailed. T-tests compared conditions on mean ratings for each item, with ratings ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), with higher ratings indicating stronger preference for that item. Chi-square tests compared conditions on number of participants who agreed with each item (rating of 5-7), neither agreed nor disagreed (rating of 4), and disagreed (rating of 1-3).

*$p < .05$; **$p < .01$; ***$p < .001$

Within the experimental condition, participants rated their satisfaction with each intervention component on a scale from 1 (*I did not like this activity*) to 5 (*I loved this activity*), with lower ratings indicating dislike of the intervention and higher ratings indicating greater enjoyment. Mean ratings and standard deviations for each intervention component are presented in Figure 4. The intervention component with the highest average rating ($M = 4.04$, $SD = .90$) was reading other people's pain stories, which was rated as "I loved this activity" by 14.3% of participants and rated as "I did not like this activity" by none of the participants. Participants were less enthusiastic about disclosing their own pain stories and related emotions, which had the second-to-lowest average rating ($M = 3.26$, $SD = 1.21$); only 5.9% "loved" it and 2.5% "did not like" it. The lowest-rated activity was a YouTube video about validation ($M = 3.10$, $SD = 1.27$), which was "loved" by 6.7% and "disliked" by 5.9%. Though this particular video had the lowest average rating, learning about and practicing validation received the second-highest average rating ($M = 3.62$, $SD = 1.16$), with 10.9% "loving" it and 2.5% "disliking" it. The remaining activities (YouTube videos on pain neurobiology education, sharing and approaching previously avoided activities due to fear of pain) were rated in the middle (Ms = 3.32 to 3.48), with 5.9% to 9.2% "loving" these activities and 0.8% to 3.4% "disliking" them.

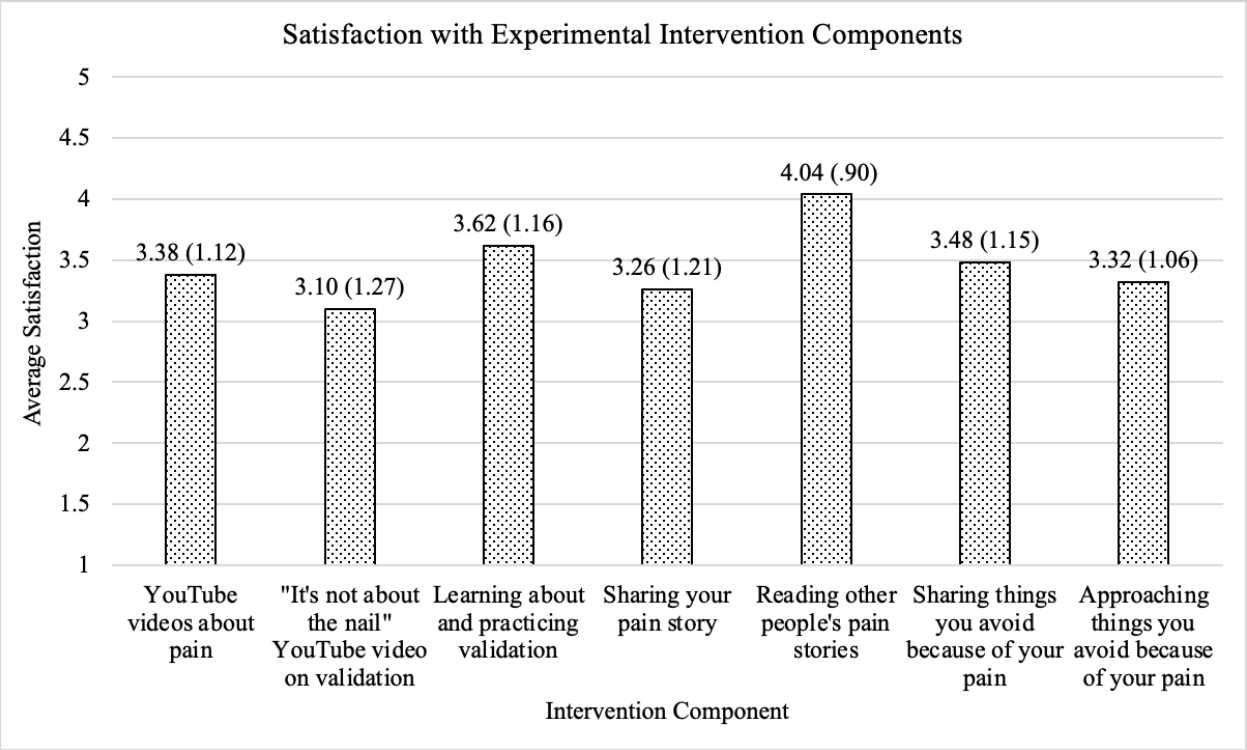

Figure 4: Experimental participants' mean ratings and standard deviations for each intervention component using a 5-point scale, with lower ratings indicating dislike of the intervention and higher ratings indicating greater enjoyment.

CHAPTER 4

DISCUSSION

Social networking-based groups such as Facebook groups have become increasingly popular among people with chronic conditions, and the affordances of such groups make them a promising platform for chronic disease intervention. Yet, there have been few controlled tests of the effects of social networking-based groups. Our team developed a Facebook-based intervention that focuses on enhancing social support by connecting adults with peers who also have chronic pain. Participants were assigned to one of two conditions: (1) a control condition (peer-led Facebook group) in which participants were instructed to offer mutual support for the duration of the group; and (2) an experimental condition (professional-led Facebook group) in which the investigators disseminated several training components that were selected based on research on social and emotional influences on pain. Intervention components included psychoeducation on pain neurobiology, emotional validation training, emotional disclosure exercises, and prompts to engage participants in activities that they have been avoiding because of their pain. Training materials included short didactics to read, videos to watch, prompts to respond to, and activities to engage in. Participants engaged in their assigned Facebook group for four weeks. Using a randomized controlled clinical trial, we tested the efficacy of this intervention; that is, whether a professional-led support group leads to greater pain-related benefits than a support group alone. We also aimed to understand who benefits the most from these groups.

Impact of Facebook-Based Support Groups

Our findings suggest the possibility that Facebook groups for chronic pain, in general, are beneficial for users. Regardless of experimental condition (professional-led or peer-led), participants showed significant reductions in pain severity, pain interference, and depressive

symptoms after participating in their assigned Facebook group for four weeks. Participants retained their outcomes one month after the Facebook groups ended, and in fact, those in the professional-led Facebook groups continued to improve significantly in pain interference. Though the overall sample did not show significant reductions in anxiety symptoms at post-intervention or 1-month follow-up, greater Facebook group use was associated with lower anxiety at post-intervention. Notably, the lack of a no-intervention control condition precludes concluding that the current Facebook groups improved pain-related outcomes; it is possible that the observed improvements stem from uncontrolled processes such as regression toward the mean, history, maturation, or repeated assessment. Nonetheless, our findings are consistent with prior research showing that online groups positively impact physical and psychological health (Bender et al., 2011; Merolli et al., 2013) and support social cognitive theories suggesting that having an encouraging support network, including supports who are successfully managing the same illness, enhances coping and adaptive health behaviors (Bandura, 1977; Brownson & Heisler, 2009; Clark & Dodge, 1999; Cobb, 1976; Cohen & Wills, 1985; Funnell, 2010; Thoits, 1986).

Our results suggest that the addition of psychological intervention pieces may continue to benefit users' functionality even when the person is no longer actively using the Facebook group. Yet, overall, participants in the professional-led condition who received empirically-supported psychosocial intervention showed no differences in outcomes at post-intervention or 1-month follow-up compared to those in the peer-led Facebook groups. In fact, only the peer-led condition showed improvements in anxiety symptoms, though these improvements were likely due to higher levels of anxiety at baseline, and therefore, a greater opportunity to improve. These findings were surprising given the large body of literature supporting the efficacy of pain neurobiology education, validation, emotional disclosure, and overcoming avoidance in improving pain

outcomes (Cano et al., 2008; Garland, 2012; Leong et al., 2015; Lumley et al., 2011, 2012; Moseley & Butler, 2015; Pester et al., 2020).

There are a few possible explanations for these largely null findings of the experimental condition. It is possible that psychosocial intervention components do not add to the utility of Facebook groups for chronic pain. That is, perhaps peer support is the driving factor of improvements. Another possibility is that participants did not sufficiently engage with the intervention pieces to yield desired effects. Despite the researchers of this study encouraging engagement in the experimental condition through use of daily prompts and activities, experimental participants had similar numbers of posts and comments as controls, with experimental participants posting, on average, only 2 to 3 times and commenting on group members' posts only 11 to 12 times throughout the duration of the one-month intervention. Approximately half of participants identified as "lurkers," and as such, visited the Facebook group regularly, but rarely, if ever, posted. Many experimental participants, therefore, might not have benefited from psychological interventions such as emotional disclosure given their suboptimal participation. Yet, predictor analyses indicated that lurkers benefited as much as, if not more, than active users in the experimental condition, suggesting that increased posting and commenting might not be vital for outcomes.

Methodological issues might have also contributed to these unexpected findings. Randomization unfortunately did not create entirely equivalent conditions at baseline. Controls appeared to be worse off at baseline compared to the experimental condition, with significantly greater pain interference, anxiety, and use of pain medications. Consequently, the control condition had greater opportunity for improvement than the experimental condition. If experimental and control conditions were equivalent at baseline, we might have found group differences in outcomes

at post-intervention and 1-month follow-up. In addition, there were somewhat greater attrition rates in the experimental condition compared to the control condition. Though none of the participants in either condition left their Facebook groups early, slightly more experimental participants did not complete post-intervention and 1-month follow-up measures compared to controls. Differences in completion rates may be attributable to the greater demand or time commitment of participating in the experimental condition, or even dislike of the intervention components, and may help explain the lack of experimental effects.

Another possibility is that some or all of the intervention pieces were ineffective or ill-fitting for this population and/or format. Though the intervention components were selected based on empirical support, the translation of these psychosocial interventions to a social media platform was largely unknown. For example, it is possible that the videos on pain neurobiology education were not viewed or were dismissed, misunderstood, or irrelevant for some participants. For example, one participant commented, "Thank you for the info. But I know what causes my chronic pain, just little I can do about it without potentially causing other issues (surgery related). I know mental practice can help but only to a certain extent unfortunately." Another participant commented, "I may be oversimplifying it but what I heard was move more…I wholeheartedly wish it were that simple!" Though participants were encouraged to discuss the content of these videos with each other, the clinical investigators did not comment or provide clarifications. This might have contributed to misunderstanding and/or aggravation by participants, who would typically receive therapist feedback in in-person clinical settings. Though emotional validation has been linked to reduced pain and greater relational satisfaction (Cano et al., 2008; Leong et al., 2015), validation training might have been inadequately executed in this setting. The YouTube video introducing validation was the lowest-rated activity by participants. Further, the lack of

feedback from the clinical investigators might have resulted in limited understanding of why validation is important and how to validate someone. For example, whereas some participants caught on quickly (e.g., "that sounds really lonely and isolating"), others demonstrated difficulty practicing validation (e.g., "I have that problem," "I might suggest doing some research…"). As a result, participants might not have properly validated each other, as the intervention intended. Research support for the benefit of experimentally-manipulated validation on individuals with chronic pain is also weak (Edlund et al., 2015; Vangronsveld & Linton, 2012), and therefore, validation training might not be a sufficient intervention for improving pain outcomes. Facebook groups might also not be conducive to eliciting emotional disclosure. Though people may generally be less inhibited online compared to in person, the use of participants' personal Facebook profiles might have negated any disinhibition effect. Participants might have felt reluctant to disclose personal emotions and stories that could be tied to their person. One participant even noted a preference for a more anonymous interface. Many participants might have also opted out of the experiential intervention of engaging in avoided activities, which required additional effort outside of the Facebook group, with minimal accountability or guidance. Only a handful of participants in the experimental condition described approaching feared or avoided activities, such as "riding a bike for the first time in 20 years," indicating potentially low engagement.

It is also possible that these specific intervention pieces were poorly timed or insufficient. Because a consistent intervention model was not used such as cognitive behavioral therapy for chronic pain, the intervention might have seemed disconnected to participants, such as following neuroscience education with teaching validation, giving participants mixed messages about the reasons for their pain and diluting the power of any single intervention piece. These training components may be more effective if delivered separately or with more therapist direction. Use of

alternate or additional intervention pieces may also enhance outcomes. Though participants overall enjoyed the intervention components, particularly reading other people's pain stories and learning and practicing validation, approximately 85% of participants would have liked to learn more strategies for dealing with pain. Additional strategies from empirically-supported psychotherapies for chronic pain (e.g., CBT, ACT, EAET) could have been disseminated, such as activity pacing, stress management, sleep hygiene, mindfulness, emotional awareness, cognitive defusion, and/or acceptance of chronic pain.

Who Benefits the Most from Facebook-Based Support Groups?

Potential moderators were examined to determine for whom Facebook-based support groups may be most beneficial. Overall, moderation analyses were largely nonsignificant, and therefore, the moderator variables were also examined as predictors of outcomes across both conditions combined. Results from predictor analyses suggest that those who perceive their friends or family members as being less supportive or invalidating tend to benefit more from the Facebook support groups. Regardless of condition, greater perceived social constraints at baseline was related to greater improvements in anxiety at follow-up, and within the control condition, greater reductions in pain interference and depressive symptoms. These findings were expected. Receiving support and validation from fellow group members might have helped to buffer the harmful effects of any invalidation or lack of support from participants' preexisting social networks. A large body of research has demonstrated the benefits of validation among people with chronic pain (Cano et al., 2008; Edmond & Keefe, 2015; Fruzzetti et al., 2005; Greville-Harris et al., 2016; Krause et al., 2003; Leong et al., 2011, 2015; Shenk & Fruzzetti, 2011; Wernicke et al., 2017). Our findings suggest that Facebook support groups are indicated for adults with chronic pain who feel unsupported or invalidated by their social networks. These individuals, in particular, may benefit

from the support and validation of fellow group members, and in turn, experience less anxiety, depression, and interference from pain. Notably, perceived social constraints was less strongly related to outcomes, especially depression, in the experimental condition, possibly because the intervention pieces extend beyond support; therefore, even participants with strong support systems outside of the Facebook group could benefit.

Also as expected, our findings indicate that those who are ambivalent about expressing their emotions (i.e., have a desire to express their emotions but fear the consequences of doing so) may especially benefit from the Facebook support groups, mainly in terms of reduced anxiety. Research has shown that ambivalence over emotional expression is linked to greater maladjustment among those with chronic pain (Carson et al., 2007; Porter et al., 2005; van Middendorp, 2010), but can be targeted through emotional disclosure exercises to reduce pain and improve functioning. In this study, those who were ambivalent about expressing their emotions might have benefited from witnessing emotional expression being modeled and reinforced within the Facebook groups. Further, such participants might have even identified and disclosed their own emotions within the Facebook group, leading to reduced internal conflict and anxiety. Notably, this effect was slightly larger, albeit not significantly, in the experimental than control condition, which is unsurprising given that experimental participants were prompted to disclose emotions.

The results of exploratory analyses indicate that those with chronic primary pain conditions, such as fibromyalgia and widespread pain, may benefit more from the Facebook groups than those with other chronic pain conditions, particularly in reduced anxiety. Whereas chronic primary pain is regarded as a disease in its own right, chronic secondary pain syndromes initially manifest as a symptom of another disease or injury, such as cancer, a motor vehicle accident, or diabetic neuropathy. Given that the majority of participants (approximately 80%) had a chronic

primary pain condition, those with secondary pain conditions might have felt disconnected or misunderstood by fellow groups members, and therefore, engaged less and/or benefited less from the Facebook groups. This theory is supported by a comment made by one of the participants who felt that it was burdensome to explain his secondary pain condition to other participants with varying pain diagnoses. The experimental condition, in particular, appeared to favor those with chronic primary pain, especially with respect to pain severity and interference. Although moderation analyses were not significant, participants with primary pain generally had better outcomes than those with secondary pain (medium effect sizes) in the experimental condition, but appeared to do similar or worse than those with secondary pain in the control condition. Within the experimental condition, some of the intervention components, such as pain neurobiology education, might have been irrelevant or even invalidating to those with secondary pain conditions, leading to poorer outcomes for these participants. Though both primary and secondary pain have biopsychosocial underpinnings, the underlying mechanisms vary and may necessitate different approaches to treatment (Treede et al., 2015). For example, chronic neuropathic pain is caused by a legion or disease of the somatosensory nervous system (Jensen et al., 2011), whereas chronic primary pain is believed to be primarily driven by central sensitization, or a persistent state of high reactivity of the central nervous system. Many of the intervention components used in the experimental condition, such as emotional disclosure, have been more often utilized, tested, and/or substantiated among chronic primary pain patients. Our findings support the use of homogenous Facebook groups based on chronic pain condition. A professional-led Facebook group may be especially beneficial for those with chronic primary pain, whereas individuals with secondary pain may benefit more from peer-support-only groups than professional-led groups, or perhaps would benefit from modified intervention components.

Finally, we explored whether Facebook group engagement was related to outcomes. Lurkers—or participants who visited the Facebook group regularly but rarely, if ever, posted—showed comparable improvements as active users—participants who visited the Facebook group regularly and posted or commented frequently—after engaging in the Facebook groups. There was some evidence suggesting that active users may have experienced greater anxiety after participating in the experimental condition compared to lurkers, whereas lurkers and active users showed similar reductions in anxiety after participating in the control condition. One explanation is that active users in the experimental condition were more likely engaging with the intervention components than lurkers, such as disclosing difficult stories and emotions. Exposure to these types of feared or avoided activities is known to increase anxiety in the short-term (Foa et al., 1986). Overall, however, our findings indicate that Facebook group members benefit regardless of whether they post regularly or predominantly lurk.

Acceptability of Facebook-Based Support Groups

Participants reported on their preferences and satisfaction with their Facebook group experience. Over 80% of participants were satisfied with their Facebook group, would recommend the group to other people with chronic pain, and found the group to be helpful. Within the Facebook groups, participants posted their appreciation for this online support group (e.g., “You helped me think about my pain in a different light”; “I can’t believe tomorrow is the last day. I’ve gotten used to talking, supporting, and getting to know everyone here”; “In this short amount of time, I have met some incredible people with amazing stories. It seems that there are as many ways to live as there are to hurt. You guys are inspirational”). Nearly all participants found the platform easy to use, and nearly 80% appreciated the online, compared to in-person, format. There was very little evidence of adverse events. A small minority (approximately 5%) of participants felt

pressured to “change things” by group members, and only three of 119 participants reported “an invasion of privacy,” explaining that they would have preferred a more anonymous interface than Facebook, single-gender rather than mixed-gender groups, and/or groups divided based on type of chronic pain condition (e.g., back pain only). Preference for homogenous groups based on type of pain condition was reported by over half of the participants.

Strengths, Limitations, and Future Directions

This research addresses gaps in the chronic pain and social support literatures by experimentally studying a naturally-occurring social process by which adults with chronic pain seek help and by testing whether clinicians can augment the healing process by disseminating psychosocial intervention through Facebook groups. This study used a rigorous randomized controlled trial to study the effects of peer-led and professional-led Facebook support groups on pain, mood, and functioning. The current study also identified participant characteristics that predict who benefits the most from this type of intervention. This work offers support for an accessible tool to enhance the lives of adults with chronic pain, and provides direction for who may benefit most from these groups and how to improve social networking-based groups to optimize outcomes and satisfaction for more users.

Still, there are notable limitations of the current study. This study did not use a no-intervention, assessment-only control condition, mainly because the primary aim was to compare professional-led and peer-led Facebook support groups. However, the lack of a no-intervention condition limits the interpretability of our time effects. Further, this study used Facebook groups created by the investigators. This allowed for greater experimental control, including random assignment of participants to conditions, equivalent number of participants per condition, similar gender diversity across conditions, and standardized duration of the Facebook groups; however,

the use of artificially-created Facebook groups limits the external validity of our findings. That is, our findings might not generalize to naturally-occurring Facebook groups for chronic pain, which often have thousands of members and potentially different dynamics.

This study was further constrained by selection bias. Many participants were recruited through social media platforms such as Facebook and Reddit, and 22.7% were already members of Facebook groups for chronic pain prior to starting this study. All participants were active Facebook users (i.e., checked Facebook at least 3 times per week), and therefore, had familiarity with this platform. Thus, the participants in this study might have been more comfortable with and open to the Facebook groups than naïve users, and the findings might not generalize to naïve users. It is also possible that participants' familiarity with Facebook groups for chronic pain interfered with the experimental condition, such that participants were accustomed to and expected a peer-led group. Further limiting the generalizability of our findings was the notable lack of diversity in our sample. Though participants were recruited internationally, nearly 90% of participants were from the United States, and of those, nearly 50% were from Michigan. The sample was also relatively homogenous, consisting primarily of White women who were partnered, employed, well-educated, and had health insurance and access to transportation. These demographics may reflect the primary users of Facebook support groups for chronic pain, and consequently, this intervention may not adequately reach underrepresented racial groups, gender-diverse individuals, or those from low socioeconomic backgrounds.

Another limitation of the current study was the use of primarily self-report measures. Aside from using objectively-counted posts and comments as proxies for engagement, all variables were measured using self-report. Outcomes such as functionality could have been measured using objective methods such as tracking devices to assess step count or sleep, and informant-reports

could have been obtained by participants' significant others, family members, or close friends. We also examined only four outcome variables—pain severity, pain interference, depression, and anxiety. More work is needed examining the impact of Facebook support groups on outcomes aside from symptom reduction, such as changes in self-efficacy and perceived support. Though experimental and control conditions did not differ in any of our main outcomes, it is possible that experimental participants showed enhanced outcomes in other ways, such as more validating comments to group members, greater perceived validation, or decreased avoidant behavior.

Quality improvement studies are needed to continually enhance and test this novel, social networking-based, psychosocial intervention. Based on our findings, we offer the following recommendations for future online support groups for adults with chronic pain. First, we recommend testing a more anonymous interface than Facebook, such as Reddit. Some participants complained about the lack of anonymity and privacy via Facebook. In line with the disinhibition effect, participants might feel less restraint if using an anonymous platform, and therefore, might be more likely to disclose emotions and experiences. We suggest considering grouping members based on gender and/or type of chronic pain condition (e.g., fibromyalgia only). Homogenous grouping is supported by our data and other literature. Research on group therapy for substance use disorders, for example, indicates potential benefits of single-gender groups compared to mixed-gender, particularly for women (Greenfield et al., 2007). Our findings also support extending online groups for longer than one month and including more than 30 members in each group. Larger group sizes could provide greater opportunity for participants to receive emotional and informational support from other group members. Finally, findings from this study indicate that psychosocial intervention components and/or clinician facilitators might not be necessary features of social networking-based groups. Not only did the experimental and control conditions

have similar outcomes, but compared to controls, a greater number of experimental participants would have preferred a peer-led support group. This preference might be due to the greater, or even unwanted, demand of engaging in the psychosocial intervention pieces. Another possibility is that the experimental participants were dissatisfied with the lack of feedback from the clinician facilitators. Accordingly, experimental participants, more than controls, wished that the clinician facilitators would have commented on their posts. Similar to in-person psychotherapy, clinician facilitators could offer feedback in the form of validation, Socratic questioning, and reflections. As discussed earlier, a modified approach to the psychosocial intervention might also yield better outcomes. The majority of participants would have preferred to learn more strategies for dealing with pain. Empirically-supported psychotherapies for chronic pain could be adapted and translated to this platform. Instead of combining disparate techniques, it might be more effective to use a consistent model (e.g., CBT for chronic pain). The current intervention integrated various psychosocial approaches, which might have given participants mixed messages and diluted the power of the intervention.

Clinical Implications and Conclusions

Findings from this study indicate that Facebook-based support groups may benefit adults with chronic pain, particularly those who feel unsupported or invalidated by friends and family, are ambivalent about expressing emotions, and have chronic primary pain. There was little evidence of adverse events. Thus, this study supports the use of Facebook-based support groups as an additional tool to address chronic pain and its impact on mood and functioning. Our findings suggest that clinician facilitators may not be needed to guide these groups and that peer support may be the driving factor of improvements. Alternatively, the psychosocial intervention components used in the current study—pain neurobiology education, emotional validation

training, emotional disclosure exercises, and prompts to overcome avoidance—may have been ineffective, or more therapist direction may be warranted. Quality improvement studies are needed to enhance and test this novel experimental intervention, which could potentially reduce barriers to treatment for this critical public health problem.

APPENDIX A

FACEBOOK GROUP SCHEDULE AND MATERIALS

Day 1

Experimental and Control: [INTRODUCTIONS AND ICEBREAKER DAY 1]

- **9 am:** Hi everyone, welcome to your Facebook group! Our names are Bethany Pester and Hallie Tankha, and we are pain researchers out of Wayne State University in Detroit, Michigan. To get to know each other, we welcome you to briefly introduce yourself and, as a fun icebreaker, share something that brings you joy, that you value, or that you're grateful for. Feel free to include photos!

  As a reminder, please turn on your notifications for this group so you're notified when new posts are made. (Select "All Posts" under "Notification" settings).

Day 2

Experimental and Control: [INTRODUCTIONS AND ICEBREAKER DAY 2]

- No new content. Introductions and icebreaker continued from day 1.

Day 3

Experimental: [PSYCHOEDUCATION DAY 1]

- **9 am:** Thank you for participating in the activity. As this is a social support group for chronic pain, we encourage you to make use of this support network however you would like. Over the next month, through [DATE], we will post materials (pinned at the top of the page as "Announcements") that may help you learn more about your pain and will encourage you to participate in online activities within the group. Feel free to participate as much or as little as you like. In addition to what we post, we welcome you to post

questions, comments, and general thoughts whenever you would like. This group is available 24/7.

When you think about your pain, you may feel many different emotions including anger, frustration, sadness, worry, and hopelessness. You may also feel helpless because you do not know what causes your pain or what you can do to decrease it. You are not alone. Many pain researchers know how stressful pain can be, and they are trying to understand what causes chronic pain and what we can do about it. Dr. Lorimer Moseley is a pain researcher from Australia who studies the biological, psychological, and social causes of persistent pain. He created this 5-minute video to explain how some pain works and new approaches to help reduce your pain. What are your thoughts?

https://www.youtube.com/watch?v=ikUzvSph7Z4 (5-minute video: "Tame the Beast—It's Time to Rethink Persistent Pain")

Control:

- **9 am:** Thank you for participating in the activity. We're now handing the group over to you for the next month, through [DATE]. This is a social support group for chronic pain and we encourage you to make use of this support network however you would like. We welcome you to post questions, comments, and general thoughts at any time. This group is available 24/7. As a reminder, please turn on your notifications for this group.

Day 4

Experimental: [PSYCHOEDUCATION DAY 2]

- No new content. Discussion continued from day 3.

Control: N/A

Day 5

Experimental: [VALIDATION TRAINING DAY 1]

9 am: Some people who experience persistent pain share how they often feel unheard or misunderstood by people close to them, especially because they feel like others don't understand their pain. That is, they often feel invalidated by others (e.g., significant others, family, children, friends, healthcare professionals). Have you experienced this? Can you relate to this 2-minute video?

https://www.youtube.com/watch?v=-4EDhdAHrOg (1:41-minute video: "It's Not About the Nail")

Control: N/A

Day 6

Experimental: [VALIDATION TRAINING DAY 2]

- **9 am: Why does validation matter?**

  Researchers have found that when we feel **validated** (heard, understood), we feel better physically and emotionally, and people even report feeling less pain. On the flipside, when we feel **invalidated** (ignored, criticized, unheard, misunderstood), we may experience more pain, anxiety, and distress.

  Unfortunately, being validating is not always easy, especially when we don't understand where the other person is coming from. Just like any other skill, we can learn to validate others (and ourselves). Over the next few days, we'll provide some tips and opportunities to practice validation. **In the meantime, what kind of things do other people in your life do or say that make you feel validated *or* invalidated?**

Control: N/A

Day 7

Experimental: [VALIDATION TRAINING DAY 3]

- **9 am:** We encourage you to continue to share and discuss the kinds of things other people in your life do or say that make you feel validated *or* invalidated.

Control: N/A

Day 8

Experimental: [VALIDATION TRAINING DAY 4]

- **9 am: "Most people do not listen with the intent to understand, they listen with the intent to reply." -Stephen Covey**

  How do we validate one another? If the goal is to let the other person know that we hear and understand them, there are steps we can take and language we can use to communicate our empathy.

  1. **Step 1**: Listen closely to the other person.
  2. **Step 2**: Try to figure out what the person is feeling as they talk (e.g., worried, sad, angry, excited).
  3. **Step 3**: Respond when the person stops talking. Some helpful ways to respond: "That's understandable you would feel angry," "It sounds like you're feeling disappointed," "I wonder if you feel frustrated," "I get it, I've been there."

  Want to practice? Pretend someone were to say to you, "I was really hoping that the surgery would take away the pain…and it did for a while, but then slowly, it came back."

  What emotion might this person be feeling? #ValidateMe

Control: WEEK 2

- **9 am:** Thanks to everyone for your posts, comments, and discussion so far. We encourage you to continue to make use of this support network as we head into the second week.

Day 9

Experimental: [VALIDATION TRAINING DAY 5]

- **9 am [PINNED POST]:** Yesterday we talked about how to validate others and ourselves. We created some posts below with statements you may have heard or even said before yourself. How would you validate these statements? (We will post 4). Comment with your ideas!
- **9:01 am: (1/4) What could you say to validate someone who said:** "I tried to tell the doctor that the medications weren't helping but it's like he didn't believe me." **#ValidateMe**
- **9:02 am: (2/4) What could you say to validate someone who said:** "When I finally feel like I am having a good day, I push myself...but then I really pay for it the next day." **#ValidateMe**
- **9:03 am: (3/4) What could you say to validate someone who said:** "The doctor told me about this new surgery yesterday, but I really don't think it is going to help." **#ValidateMe**
- **9:04 am: (4/4) What could you say to validate someone who said:** "After a while, my friends stopped asking me to do things because I always said no." **#ValidateMe**

Control: N/A

Day 10

Experimental: [VALIDATION TRAINING DAY 6]

- **9 am: Validation can be challenging sometimes. Here are some examples of validation roadblocks and what you can do:**
    1. **You want to validate someone, but they are doing something dangerous that you don't agree with.**

       For example: You notice your friend is drinking heavily to cope with pain.

       What to do: Validate their feelings or point of view, but not what the person does. For example, "I can see that you are obviously in a lot of pain."
    2. **You want to validate someone, but they are putting themselves down.**

       For example: "I shouldn't be sad about my pain. I should suck it up and deal with it. I'm such a baby."

       What to do: Try to understand what they might be feeling and convey understanding of the emotion. For example, "You aren't a wimp, it is understandable to feel sad about your pain."
    3. **You want to validate someone, but you don't understand their thoughts or feelings.**

       What to do: Admit that you don't understand but want to understand. For example, "I want to understand this, but I don't yet get it. Let's keep talking. Tell me again."

Control: N/A

Day 11

Experimental: [EMOTIONAL DISCLOSURE DAY 1]

- **9 am:** We've discussed how experiencing persistent pain can affect people's lives, including relationships, functioning, work, and emotions.

  What is your pain story?

  We invite you to think about your personal journey and then post your story to share with the group.

  We encourage you to spend the next few days thinking about your pain journey, sharing it with the group, and reading and commenting on others' stories. This is an opportunity to support and validate one another. (Please begin a new post, rather than replying to this post). [Note: turn off commenting on original post].

Control: N/A

Day 12

Experimental: [EMOTIONAL DISCLOSURE DAY 2]

- **9 am:** Thank you to everyone who has had the chance to share your pain journey with the group. We encourage you to continue sharing your stories, and reading and responding to others' posts.

Control: N/A

Day 13

Experimental: [EMOTIONAL DISCLOSURE DAY 3]

- **9 am:** Thank you to everyone who has had the chance to share your pain journey with the group. We encourage you to continue sharing your stories, and reading and responding to others' posts.

Control: N/A

Day 14

Experimental: [EMOTIONAL DISCLOSURE DAY 4]

- **9 am: Today we invite you to explore your emotions and thoughts about your pain story**. Tie your pain journey to other parts of your life: your childhood, relationships with others (e.g., parents, partners, friends, relatives, or other people important to you), job or education, hobbies, finances, goals, or losses (this could be a loss of a loved one, loss of identity, or loss of your former pain-free self).

  How have these areas of your life impacted your pain and/or how has your pain impacted your life?

  Do not worry about form or style, spelling, punctuation, sentence structure, or grammar. Everything you share stays within the group. (Please begin a new post, rather than replying to this post). [Note: turn off commenting on original post].

Control: N/A

Day 15

Experimental: [EMOTIONAL DISCLOSURE DAY 5]

- **9 am:** Thank you to everyone who has had the chance to share your thoughts and emotions related to your pain story. We encourage you to continue sharing, and reading and responding to others' posts. Even if you've already shared how pain has impacted one aspect of your life, we welcome you to think about and share how pain has impacted other aspects (examples: your childhood, relationships with others, job or education, hobbies, finances, goals, losses, etc.), or how your life has impacted your pain (examples: maybe you noticed an increase in pain after a job loss, divorce, death of a loved one).

Control: WEEK 3

- **9 am:** Thanks to everyone for your posts, comments, and discussion so far. We encourage you to continue to make use of this support network as we head into the third week.

Day 16

Experimental: [EMOTIONAL DISCLOSURE DAY 6]

- **9 am:** Thank you to everyone who has shared their pain stories so far. We can tell that many of you took a good amount of time thinking about and writing your stories, and it is wonderful that you gave others the opportunity to read your personal pain story. Hopefully you have found that sharing your story, and reading others' stories, was beneficial in some way.

  We did notice that many have not shared their stories or commented on others' stories, and we want to open up a discussion about anything that may have been difficult about this activity.

Control: N/A

Day 17

Experimental: [EMOTIONAL DISCLOSURE DAY 7]

- **9 am:** For some of you, you may have shared your journey, thoughts, and emotions many times before. For others, this may have been your first time disclosing these personal experiences. **What connections, if any, did you make between your life experiences, emotions, and pain?** (Please begin a new post, rather than replying to this post). [Note: turn off commenting on original post].

Control: N/A

Day 18

Experimental: [EMOTIONAL DISCLOSURE DAY 8]

- **9 am:** Thank you to everyone who has had the chance to think about and share the connections between your life experiences, emotions, and pain. We encourage you to continue sharing, and reading and responding to others' posts.

Control: N/A

Day 19

Experimental: [EMOTIONAL DISCLOSURE DAY 9]

- **9 am:** Thank you to everyone who has had the chance to think about and share the connections between your life experiences, emotions, and pain. We encourage you to continue sharing, and reading and responding to others' posts.

Control: N/A

Day 20

Experimental: [OVERCOMING AVOIDANCE DAY 1]

- **9 am:** After thinking about the ways that pain has impacted your life, you may have noticed that there are things you have stopped doing or avoid doing because of your pain. These things can include **activities you used to enjoy** (e.g., going on walks, sitting through your child's sporting event, spending time with friends, intimacy), **daily tasks** (e.g., laundry, dishes, gardening/yard work), **situations that remind you of your pain** (e.g., where you got injured), and **things that may be emotionally difficult** (e.g., telling your partner, friends, or family what kind of support you need). **What are some things that you have stopped doing or avoid doing because of your pain?**

Control: N/A

Day 21

Experimental: [OVERCOMING AVOIDANCE DAY 2]

- **9 am:** *This post may not apply to everyone in this group, as we know that everyone has different kinds of pain. However, we wanted to share this information because it may be helpful for some!*

  People with pain often share that they avoid movement because they worry that they will hurt themselves and/or their pain will get worse. On the contrary, researchers have found that movement is one of the most helpful ways to recover from chronic pain, and **it is almost always safe to move**.

  If you are someone who is afraid to move, you are not alone! **Some people find it helpful to know that…**

  1. Our bodies adapt really well to the demands of life. Even if our injuries don't heal perfectly, our bodies will return to as close to normal functioning as possible. **If you were injured more than three to six months ago, your body is likely done healing.** Unfortunately, this doesn't mean that we stop hurting, and pain can still be severe even after an injury has healed. This is our pain system being overprotective and trying to keep us safe. **By continuing to move, we are teaching our pain system that we are safe and do not need protection**, because, despite our pain, we are not re-injuring ourselves. Overtime, you may notice that your pain starts to decrease because your pain system has learned to stop over-signaling pain.
  2. **If you have back pain, have you been diagnosed with a "bulging," "herniated," or "slipped" disc?** Clinical researchers have found that 50% of people age 40 and older have a bulging disc and don't have back pain. Therefore, disc problems may

just be a normal part of aging. Healthcare providers have found that many things found on scans are perfectly normal and common, even in people who do not have pain!

Feel free to share questions or comments! If you're interested in learning more, visit Dr. Moseley's website: https://www.tamethebeast.org

Control: N/A

Day 22

Experimental: [OVERCOMING AVOIDANCE DAY 3]

- **9 am: Over the next week, we invite you to approach the things that you have been avoiding, whether it be activities you used to enjoy, daily tasks, situations that remind you of your pain, and/or things that may be emotionally difficult. We invite you to share your experiences with the group.** You can talk about every step of the process, like what you were planning to do, what the experience was like when it was happening, and how you felt afterward. We are here to support each other, so if you are struggling with approaching what may be painful or scary, we encourage you to reach out and ask for help. We want you to share your successes, and it can be just as comforting to share your challenges and get advice and encouragement from others.

Control: WEEK 4

- **9 am:** Thanks to everyone for your posts, comments, and discussion so far. We encourage you to continue to make use of this support network as we head into the final week of the Facebook group.

Day 23

Experimental: [OVERCOMING AVOIDANCE DAY 4]

- No new content. Overcoming avoidance continued from day 22.

Control: N/A

Day 24

Experimental: [OVERCOMING AVOIDANCE DAY 5]

- No new content. Overcoming avoidance continued from day 22.

Control: N/A

Day 25

Experimental: [OVERCOMING AVOIDANCE DAY 6]

- No new content. Overcoming avoidance continued from day 22.

Control: N/A

Day 26

Experimental: [OVERCOMING AVOIDANCE DAY 7]

- No new content. Overcoming avoidance continued from day 22.

Control: N/A

Day 27

Experimental and Control: [TERMINATION DAY 1]

- **9 am:** Good morning, everyone. Tomorrow is the last day to participate in this group. The group will be deactivated tomorrow evening at 12am EST, and you will no longer have access. If you have any final thoughts or messages, we encourage you to share.

Day 28

Experimental and Control: [TERMINATION DAY 2]

- **9 am:** We would like to thank you for your participation in this group. We appreciate your time and dedication to this support group and for the help you offered to other people who experience pain. We hope you enjoyed your experience and found the group valuable and helpful.

  As a reminder, the group will be deactivated this evening at 12am EST, and you will no longer have access. Please check your e-mail for a post-group survey.

APPENDIX B

GENERAL SOCIAL CONSTRAINTS SCALE (GSC)

Completed at Baseline

Sometimes, even when your friends and family members have good intentions, they may say or do things that upset you. Think about the PAST MONTH and indicate how often your friends or family members did the following things.

Use the scale that ranges from:

1 = Never

2 = Rarely

3 = Sometimes

4 = Often

How often in the past month have your friends or family members…

1. Changed the subject when you tried to discuss your problems?
2. Seemed that they did not understand your situation?
3. Avoided you?
4. Minimized your problems?
5. Seemed to be hiding their feelings?
6. Acted uncomfortable when you talked about your problems?
7. Trivialized your problems?
8. Complained about their own problems when you wanted to share yours?
9. Acted cheerful around you to hide their true feelings and concerns?
10. Told you not to worry so much about your problems?
11. Told you to try not to think about your problems?

12. Given you the idea that they didn't want to hear about your problems?
13. Made you feel as though you had to keep your feelings about your problems to yourself, because they made them feel uncomfortable?
14. Made you feel as though you had to keep your feelings about your problems to yourself, because they made them upset?
15. Let you down by not showing you as much love and concern as you would have liked?

APPENDIX C

AMBIVALENCE OVER EMOTIONAL EXPRESSIVENESS QUESTIONNAIRE (AEQ)

Completed at Baseline

Below are some statements that refer to how people sometimes feel and act. Using the following scale, rate each statement to indicate how frequently you have felt or experienced each one.

1	2	3	4	5
I have never felt like this				I feel like this a lot

The statement may consist of 2 thoughts. Carefully read the statement as a whole before deciding on how characteristic it is of you. For example, consider the item:

"I try to honestly criticize others for their own good, but I worry they may get angry with me if I do so"

You would give this item a high rating ***if and only if*** both parts of the statement apply to you; that is, you try to honestly criticize others ***and*** you worry about their getting angry. If only one part of the statement applies to you, you would give this item a lower rating. It is important to consider the complete thoughts being expressed before you respond.

1. I make an effort to control my temper at all times even though I'd like to act on these feelings at times.
2. Often I'd like to show others how I feel, but something seems to hold me back.
3. I try to refrain from getting angry at my family even though I want to at times.
4. I try to show people that I love them, although at times I am afraid that it may make me appear weak or too sensitive.
5. Often I find that I am not able to tell others how much they really mean to me.
6. I want to tell someone when I love them, but it is difficult to find the right words.

7. I would like to express my disappointment when things don't go as well as planned, but I don't want to appear vulnerable.
8. I would like to be more spontaneous in my emotional reactions, but I just can't seem to do it.
9. I try to suppress my anger, but I would like other people to know how I feel.
10. It is hard to find the right words to indicate to others what I am really feeling.
11. I worry that if I express negative emotions such as fear and anger, other people will not approve of me.
12. I feel guilty after I have expressed anger to someone.
13. I often cannot bring myself to express what I am really feeling.
14. After I express anger at someone, it bothers me for a long time.

APPENDIX D

BRIEF PAIN INVENTORY (BPI): PAIN SEVERITY

Completed at Baseline, Post-Intervention, and 1-Month Follow-Up

1. Please rate your pain by selecting the number that best describes your pain at its **worst** during the **past week.**
2. Please rate your pain by selecting the number that best describes your pain at its **least** during the **past week.**
3. Please rate your pain by selecting the number that best describes your pain on **average** during the **past week.**
4. Please rate your pain by selecting the number that tells how much pain you have **right now.**

Scale of 0 (No pain) to 10 (Pain as bad as you can imagine) was included with each item.

APPENDIX E

BRIEF PAIN INVENTORY (BPI): PAIN INTERFERENCE

Completed at Baseline, Post-Intervention, and 1-Month Follow-Up

Select the number that describes how, during the **past week**, pain has interfered with your:

1. General activity
2. Mood
3. Walking ability
4. Normal work (includes work both outside the home and housework)
5. Relations with other people
6. Sleep
7. Enjoyment of life

Scale of 0 (No pain) to 10 (Pain as bad as you can imagine) was included with each item.

APPENDIX F

PROMIS® EMOTIONAL DISTRESS – DEPRESSION – SHORT FORM 8A V1.0

Completed at Baseline, Post-Intervention, and 1-Month Follow-Up

In the **past seven (7) days**…

1. I felt worthless.
2. I felt helpless.
3. I felt depressed.
4. I felt hopeless.
5. I felt like a failure.
6. I felt unhappy.
7. I felt that I had nothing to look forward to.
8. I felt that nothing could cheer me up.

Scale of 1 (Never), 2 (Rarely), 3 (Sometimes), 4 (Often), 5 (Always) was included with each item.

APPENDIX G

PROMIS® EMOTIONAL DISTRESS – ANXIETY – SHORT FORM 8A V1.0

Completed at Baseline, Post-Intervention, and 1-Month Follow-Up

In the **past seven (7) days**…

1. I felt fearful.
2. I found it hard to focus on anything other than my anxiety.
3. My worries overwhelmed me.
4. I felt uneasy.
5. I felt nervous.
6. I felt like I needed help for my anxiety.
7. I felt anxious.
8. I felt tense.

Scale of 1 (Never), 2 (Rarely), 3 (Sometimes), 4 (Often), 5 (Always) was included with each item.

APPENDIX H

ACCEPTABILITY ITEMS

Completed at Post-Intervention

Please rate how much you agree or disagree with each statement.

1. I was satisfied with my group experience.
2. I would recommend this group to others.
3. I wish the group continued for longer than 1 month.
4. I liked that this support group was online rather than in-person.
5. Overall, I found this group to be helpful.
6. The Facebook group was easy to use.
7. My group members pressured me to change things I was uncomfortable with.
8. I would have preferred to be in a Facebook group not run by clinicians, but rather a group that only had other people with chronic pain.
9. I would have preferred a group with more people.
10. I would have preferred a group with less people.
11. Other group members introduced me to new ways of managing my pain.
12. I would have liked if the clinical researchers commented on my posts.
13. I would have liked to learn more strategies for dealing with pain.
14. I would have liked to be in a support group in which everyone in the group had the same kind of pain as me (e.g., fibromyalgia, back pain, endometriosis, etc.).

Scale of 1 (Strongly disagree), 2 (Disagree), 3 (Somewhat disagree), 4 (Neither agree nor disagree), 5 (Somewhat agree), 6 (Agree), 7 (Strongly agree) was included with each item.

Experimental condition only:

Please indicate how much you liked each activity.

1	2	3	4	5
I did not like this activity				I loved this activity

1. YouTube videos about pain.
2. "It's not about the nail" YouTube video on validation.
3. Learning about and practicing validation.
4. Sharing your pain story.
5. Reading other people's pain stories.
6. Sharing things that you avoided because of your pain.
7. Approaching things you were avoiding because of your pain.

APPENDIX I

IMPUTATION OF MISSING DATA

Participants who did not complete weekly, post-intervention, and/or follow-up measures:

Weekly

Week 1 (n = 13, 10.9% missing data)

Week 2 (n = 25, 21.0% missing data)

Week 3 (n = 28, 23.5% missing data)

Self-reported engagement with the Facebook group was assessed weekly (weeks 1, 2, and 3) and post-intervention (week 4), including:

- Self-reported frequency of Facebook group use: If a participant did not report on their Facebook group use for 1 or more weeks, their missing data were extrapolated using their average reported use from the remaining weeks, then a sum and mean were computed across all 4 weeks. Only 3 (out of 119) participants were missing data across all four time points.
- Self-reported "Lurker" vs. "Active User": 11 (out of 119) participants did not complete post-intervention measures and, therefore, were missing data for this measure of engagement. This was a unique question, so missing data were not replaced.

Post-intervention

(n = 11, 9.2% missing data)

Regression imputation (IVs):

- Pain severity (baseline, week 1, week 2, week 3 pain severity)[1]
- Pain interference (baseline, week 1, week 2, week 3 pain interference)[1]
- Depression (baseline depression)

- Anxiety (baseline anxiety)

[1]Pain severity and pain interference data were collected each week as part of the larger study.

- Acceptability data (e.g., satisfaction) were obtained post-intervention, but missing data were not replaced as these questions were highly unique.

1-month follow-up

(*n* = 17, 14.3% missing data)

Regression imputation (IVs):

- Pain severity (baseline, week 1, week 2, week 3, post-intervention pain severity)
- Pain interference (baseline, week 1, week 2, week 3, post-intervention pain interference)
- Depression (baseline, post-intervention depression)
- Anxiety (baseline, post-intervention anxiety)

<u>Participants who were missing individual items on measures</u>:

Baseline

Ambivalence over emotional expressiveness questionnaire (AEQ):

- 3 participants (IDs: 41, 132, 189): Replaced missing items with the mean of the participants' existing items, then computed the mean

Pain severity:

- 1 participant (ID: 159): Replaced missing item ("current pain") with the mean of the participant's existing items, then computed the mean

Pain interference:

- 2 participants (IDs: 8, 159): Replaced with the participants' pain interference total score at week 1, which was similar to their existing pain interference items at baseline

Post-intervention

Pain severity:

- 1 participant (ID: 159): Replaced first missing item ("least pain") with the participant's reported "average pain," which was their lowest pain rating; replaced second missing item ("current pain") with the mean of the participant's existing items; then computed the mean

Pain interference:

- 2 participants (IDs: 5, 159): Replaced missing items with the mean of the participants' existing items, then computed the mean

Anxiety:

- 1 participant (ID: 121): Replaced missing items with the mean of the participant's existing items, then computed the mean

1-month follow-up

Pain severity:

- 2 participants (IDs: 41, 60): Replaced missing item ("current pain") with the mean of the participants' existing items, then computed the mean
- 2 participants (IDs: 2, 174): Replaced missing item ("least pain") with the participants' reported "average pain," which was their lowest pain rating, then computed the mean
- 2 participants (IDs: 80, 159): Replaced first missing item ("least pain") with the participants' reported "average pain," which was their lowest pain rating; replaced second missing item ("current pain") with the mean of the participants' existing items; then computed the mean

Pain interference:

- 3 participants (IDs: 26, 121, 174): Replaced missing items with the mean of the participants' existing items, then computed the mean

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ABSTRACT

THE EFFICACY OF A NOVEL FACEBOOK-BASED PSYCHOSOCIAL INTERVENTION FOR ADULTS WITH CHRONIC PAIN: A RANDOMIZED CLINICAL TRIAL

by

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Major: Psychology (Clinical)

Degree: Doctor of Philosophy

Social networking-based groups such as Facebook groups have become increasingly popular among people with chronic conditions, and the affordances of such groups make them a promising platform for chronic disease intervention. Yet, there have been few controlled tests of the effects of social networking-based groups. Our team developed a Facebook-based intervention that focuses on enhancing social support by connecting adults with peers who also have chronic pain. Using a randomized controlled clinical trial, we aimed to understand the efficacy of this intervention and to explore whether a professional-led support group leads to greater effects than a support group alone. The study sample included 119 adults with chronic nonmalignant pain. Participants were randomly assigned to one of two conditions: (1) a control condition (peer-led Facebook group; n = 60) in which participants were instructed to offer mutual support for the duration of the group and (2) an experimental condition (professional-led Facebook group; n = 59) in which the investigators disseminated several training components that were selected based on research on social and emotional influences on pain. Participants engaged in their assigned Facebook group for four weeks and completed a battery of measures at baseline, weekly, post-

intervention, and 1-month follow-up. Across conditions, participants showed significant reductions in pain severity, pain interference, and depressive symptoms after participating in their Facebook groups for four weeks (medium to large effects). Participants retained their outcomes one month after the Facebook groups ended, and those in the professional-led Facebook groups continued to improve significantly in pain interference. The overall sample did not show significant reductions in anxiety symptoms at post-intervention or 1-month follow-up, but greater Facebook group use was associated with lower anxiety at post-intervention. Between-group analyses showed no significant differences between conditions at post-intervention or 1-month follow-up. Findings from this study indicate that Facebook-based support groups may be beneficial and enjoyable for adults with chronic pain, particularly those who feel unsupported or invalidated by friends and family, are ambivalent about expressing emotions, and have chronic primary pain. There was little evidence of adverse events. Thus, this study supports the use of Facebook-based support groups as an additional tool to address chronic pain and its impact on mood and functioning. Quality improvement studies are needed to enhance and test this novel experimental intervention, which could potentially reduce barriers to treatment for this critical public health problem.

AUTOBIOGRAPHICAL STATEMENT

Though originally from the East Coast, I migrated to the Midwest to attend the University of Michigan, where I earned my Bachelor of Arts degree in psychology with Highest Distinction. I continued to reside in Ann Arbor after graduating in 2012 for three years of postbaccalaureate research with an interdisciplinary team in the UM Psychiatry–Neuropsychology department, where I investigated the cognitive, biological, and functional aspects of bipolar disorder and depression. During this time, I discerned my own interests in the complex relationships between the brain, environment, and psychogenic conditions such as pain. Upon matriculating into the Clinical Psychology Ph.D. program at Wayne State University in 2015, I have been committed to understanding the psychosocial basis of pain.

My extensive research and clinical training in pain psychology has solidified my dedication to the field of pain and equipped me with foundational skills to understand and treat pain from a biopsychosocial lens. As a clinical psychology doctoral student working with Drs. Mark Lumley and Annmarie Caño at Wayne State University, I have undertaken a variety of research roles to investigate the impact of psychosocial influences on pain. To further advance my training in pain medicine, I have collaborated with interdisciplinary teams within the Medical University of South Carolina (MUSC) and hospital systems across Michigan to study chronic pain and other medical and psychiatric conditions. My experiences have shown me that an interdisciplinary approach cultivates creative and innovative projects with a truly biopsychosocial orientation. Following my predoctoral psychology internship at the Charleston Consortium (MUSC), I will be returning to the Northeast for a postdoctoral fellowship in pain psychology with an interdisciplinary team at Brigham and Women's Hospital / Harvard Medical School. With this work, I hope to substantially improve the lives of people with chronic pain.