

Connecting Pain Intensity to Work Goal and Lifestyle Goal Progress:  
Examining Mediation and Moderation Using Multi-Level Modeling

by

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## ABSTRACT

The present study examined the association of pain intensity and goal progress in a community sample of 132 adults with chronic pain who participated in a 21 day diary study. Multilevel modeling was employed to investigate the effect of morning pain intensity on evening goal progress as mediated by pain's interference with afternoon goal pursuit. Moderation effects of pain acceptance and pain catastrophizing on the associations between pain and interference with both work and lifestyle goal pursuit were also tested. The results showed that the relationship between morning pain and pain's interference with work goal pursuit in the afternoon was significantly moderated by a pain acceptance. In addition, it was found that the mediated effect differed across levels of pain acceptance; that is: (1) there was a significant mediation effect when pain acceptance was at its mean and one standard deviation below the mean; but (2) there was no mediation effect when pain acceptance was one standard deviation above the mean. It appears that high pain acceptance significantly attenuates the power of nociception in disrupting one's work goal pursuit. However, in the lifestyle goal model, none of the moderators were significant nor was there a significant association between pain interference with goal pursuit and goal progress. Only morning pain intensity significantly predicted afternoon interference with lifestyle goal pursuit. Further interpretation of the present findings and potential explanations of those inconsistencies are elaborated on discussion. Limitations and the clinical implication of the current study were considered, along with suggestions for future studies.

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## INTRODUCTION

The concept of chronic pain has traditionally been approached from a restricted viewpoint, often regarded exclusively as a reaction to unpleasant nociceptive stimuli or physical damage (Novy, Nelson, Francis, & Turk, 1995). Presumably, physical damage stimulates sensory receptors and pain is felt as a result of direct neural transmission via the spinal cord to specific areas of the brain, such as the thalamus (Melzack & Wall, 1982). Novy and her colleagues (1995) describe the “restrictive pain perspective” as one that assumes the amount, level, or nature of sensory input is the direct and only cause of pain.

The pain process may not be as straightforward as the restrictive account suggests. Although biophysical technology has developed at an increasingly fast pace, the causes, maintenance, magnitude and exacerbation of chronic pain are still often biologically and physiologically unexplained (Turk & Holzman, 1986; Van Damme Legrain, Vogt, & Crombez, 2010). Thus, the exact definition of chronic pain remains debatable, and differs across diverse theoretical views. However, a growing consensus has been achieved by various pain researchers that the experience of chronic pain cannot merely be attributed to biophysical mechanisms. In order to thoroughly understand pain, it seems that it is necessary to integrate multiple psychological concepts (e.g., cognitive, behavioral, affective, and sensory-physical) (Novy, Nelson, Francis, & Turk, 1995).

A recent study reported that more than 30 percent of adults (i.e., individuals older than the age of 18) in the United States suffer from chronic pain, including migraine headaches, lower back pain, rheumatoid arthritis, osteoarthritis, fibromyalgia, cancer, diabetic peripheral neuropathy and so on (Johannes, Le, Zhou, Johnston, & Dworkin,

2010). Moreover, it appears that the experience of chronic pain is not only associated with one's physical health, but with mental health as well. It has been consistently reported that a considerable proportion of people who are troubled with chronic pain suffer from various psychiatric disorders such as depression, anxiety, sleep problems, substance abuse, phobias, and, recently, borderline personality disorder (Egli, Koob, & Edwards, 2012; Fishbain, Cutler, Rosomoff, & Rosomoff, 1997; Greenberg & Burns, 2003; Lawton & Simpson, 2009; McWilliams, Cox, & Enns, 2003; Sansone, Whitecar, Meier, & Murry, 2001; Weisberg & Keefe, 1997; Wilson, Eriksson, D'Eon, Mikail, & Emery, 2002). However, the direction of causation is not yet clear. The chronic experience of pain for an extended period time can lead to the development of various kinds of psychopathology, and, on the other hand, individuals who are already suffering from mental health problems are more likely to suffer from pain or express their pain due to higher pain sensitivity or lower pain threshold. Although we do not clearly understand the causal pathways yet, it is noteworthy that chronic pain and various kinds of psychopathology are highly co-morbid.

Nevertheless, it is important to note that many individuals with chronic pain are well adjusted and function as well as the non-pain, healthy population. Thus, we can ask how and why similar pain stimuli are processed and regulated differently across individuals. Examining the mechanisms of self-regulation in the experience of pain may contribute to help people with chronic pain to function adaptively and enjoy their lives.

### **Self-Regulation, Goals and Chronic Pain**

Self-regulation can be defined as follows: "a multi component, hierarchically organized process of long- and short-term goal pursuit that targets for modulation (change

as well as maintenance) a number of core psychological components including attention, action, affect and emotionality, thought and imagery, physiological responses, and animate and inanimate aspects of the environment" (Karoly, 2010, p.220). This definition clearly implies that goals serve a key role in self-regulation (although many extant conceptions of self-regulation do not focus on goal processes).

Successfully achieved goals provide meaning, energy, satisfaction, and motivation for an individual. Thus, goal pursuit is strongly associated with psychological adaptation (Affleck et al., 1998; Karoly & Ruchlman, 1996). People who are suffering from chronic pain are no different from the rest of the population with respect to pursuing and achieving goals because all human beings are intrinsically goal-directed. Pain engenders a significant amount of physical and emotional stress and restriction of physical activities (Karoly & Ruchlman, 1996). Thus, pain can serve as a powerful disrupter of goal pursuit, daily emotional well-being, and cognition of important goals (Affleck et al., 2001; DeWitte, Van Lankveld & Crombez, 2011; Karoly & Ruchlman, 1996, 2007).

Acute pain, which happens to almost everyone, tends not to seriously hamper one's function in daily life. However, problems begin when the pain persists past the point of healing. According to Price and Harkins (1992), when an individual starts to experience chronic pain, he or she may appraise it as a temporary interruption. However, as pain is continuously experienced, individuals may respond to it more reflectively and may be motivated to alter their plans for achieving their personal goals. However, the process does not appear to stop here. It has also been suggested that repeated failure or disturbance in attaining goals due to pain can cause people to develop a negative or self-

defeating self-schema (Karoly & Jensen, 1987). Maladaptive schemas often inhibit social and physical activities (e.g., "I will not be able to enjoy having dinner with friends because I cannot sit for a long time due to my back pain"; "I will not be able to play soccer anymore because my joints are sore"). Schemas may also induce overdependence on analgesic medication (Karoly & Ruehlman, 1996). Furthermore, it has consistently been reported that repeated disruption in pursuing and achieving one's goal can have a negative influence on one's mental health (e.g., depression and anxiety; Jensen & Karoly, 1991; Jensen, Turner, Romano, & Karoly, 1991), can foster pain induced fear (Karoly, Okun, Ruehlman, & Pugliese, 2008) or fear avoidance (Crombez, Eccleston, Van Damme, Vlaeyen, & Karoly, 2012) and may undermine subjective well-being (Pomaki, Karoly, & Maes, 2009).

### **Review of Pain Interference with Goal Process**

How pain influences various aspects of goal processing has been widely examined. For example, Karoly and Ruehlman (1996) reported that persistent pain is likely to increase negative work goal cognition, such as self-criticism, as well as negative affect and may decrease positive goal construal (lower perceptions of value, self-efficacy and positive arousal). Also, compared to people without pain, people with chronic pain appear to experience greater conflict between work and non-work goals (Karoly & Ruehlman, 1996). A similar study was conducted by Massey and her colleagues (2007) with adolescents with headaches (N = 1210). These investigators found that the more frequent the experience of pain (i.e., headache), the more frustration the adolescents experienced with pursuing their health-related, school, and social goals. Although these studies provide preliminary evidence on how pain is associated with maladaptive goal

construal, their cross-sectional nature precludes drawing causal inferences. In addition, by only investigating between-person differences such studies cannot address the process and dynamics of daily goal pursuit in the face of pain.

Thus, some researchers have started using the within-person approach to address some of these important limitations. For example, Affleck and his colleagues investigated how pain hinders progress towards personal goals using a daily diary analysis (Affleck et al., 1998; Affleck et al., 2001). They found that when fibromyalgia patients' pain and fatigue levels increased throughout the day, these patients reported more barriers in achieving goals accompanied by diminished pursuit and progress in reaching their social and health goals. These findings on pain and goal progress provide us with important evidence that increase in pain throughout a day may be associated with a dysfunctional self-regulatory process. However, looking only at the direct relationship between pain intensity and personal goal progress might oversimplify the mechanism of pain. This argument can be supported along several lines. First, although Affleck and his colleagues (1998) reported that an increase in pain intensity is associated with a decrease in goal progress, in reality, only a decrease in social goal progress was significantly predicted by pain intensity. Health-related goal progress was not significantly accounted for by pain change throughout the day. This finding indirectly implies that there might be room for considering some other factors that can possibly *mediate* the relationship between pain intensity and goal progress. Second, there is a logical leap involved in inferring that pain alone impacts goal progress. In other words, the causal inference that increases in pain cause a decrease in goal progress might not be sound because a mediator might explain the relationship between the two variables. Last, the experience of pain interference with

goal pursuit can differ from person to person. Individual differences in processing pain perception should be accounted before making the inference that pain predicts goal progress.

Using this rationale, I shall assume the possibility of a mediating relationship between pain intensity and goal progress operating through the mechanism of pain interference with goal pursuit. Additionally, individual differences in processing pain seem to influence the association between experience of pain and level of disturbance in goal pursuit. Hence, both mediation and moderation effects need to be considered in order to thoroughly explain the relationship between pain and goal progress.

### **Importance of Work and Lifestyle Goals**

Although repeated experience of pain has been shown to interfere with various domains of our daily activities (Karoly & Ruehlman, 2007; Naliboff, Cohen, Swanson, Bonebakker, & McArthur, 1985; van den Berg-Emons, Schasfoort, de Vos, Bussman, & Stam, 2007), to the best of my knowledge, not many studies have investigated the impact of pain on current work-related and lifestyle goal pursuit and progress.

Chronic pain disorders, such as arthritis, migraine headaches, low back pain or fibromyalgia, appear to restrict people's occupational abilities (see van Leeuwen, Blyth, March, Nicholas, & Cousins, 2006 for a review) and impact their overall lifestyle goals, including self improvement (e.g., health), social interaction, spirituality, recreation, and so on. Such interruption is associated with a decrease in work efficiency, an increase in absence rates, as well as poor lifestyle choices (e.g., restriction in exercise, unhealthy diet, and negative social interaction). Therefore, daily process research that investigates the impact of pain intensity on both occupational and lifestyle goals may uniquely contribute

to a more precise understanding of the association between chronic pain and self-regulation.

### **Development of a Hypothesized Model**

Pioneering research on pain experience and goal progress was conducted by Affleck et al (1998, 2001) using the daily process approach with female fibromyalgia patients. Based on their preliminary results, the proposed study attempts to extend and clarify the influence of pain on daily goal progress among a randomly selected group of adults (both males and females) with chronic pain. First, I shall include pain interference of work- and lifestyle goal pursuit in the model as a mediator that links the level of pain intensity and later work goal progress, grounded upon logical reasoning explained above. Second, although much evidence suggests that there are some individual cognitive differences (e.g., pain acceptance and pain catastrophizing) in processing and perceiving pain, no studies, to my knowledge, have examined how these individual differences impact the day-to-day relationship between an individual's pain level and its interference with work- and lifestyle goal pursuit. Therefore, pain acceptance and pain catastrophizing were included as moderators in the model so as to demonstrate how these between-person differences influence the within-person relationship between pain experience and interference with goal pursuit. Last, while most studies have been cross-sectional, the present study shall employ multi-level modeling, a sophisticated form of within-person analysis, to address the hypotheses. In addition, in contrast to many of other daily diary studies that measure all variables once at the end of the day, the proposed study will be measuring some variables three times a day (i.e., morning, afternoon, and evening). Thus, the proposed study satisfies the temporal precedence criterion for predicting dependent



variables. Figure 1 represents the hypothesized model. Further explanations of each path will be discussed below.

### **Pain and Its Interfering Effects on Work- and Lifestyle Goal Pursuit and Progress**

Several studies have supported the contention that pain interferes with normal life functioning including pursuit and progress of personal goals (Affleck et al., 1998, 2001; Karoly & Ruehlman, 2007; Ruehlman, Karoly, & Taylor, 2008). How exactly does a change in pain level lead to interference of one's goals? A number of researchers, including Crombez and his colleagues (2005), argue that *attention* may be the key to understanding the impact of pain perception on goal pursuit. Indeed, efforts have been made to investigate the mechanism of pain interference with goals and one of the most plausible mechanisms thus far appears to be based upon attentional bias theory.

Several cognitive and evolutionary explanations exist for how pain leads to attention bias. For example, a common explanation for the mechanism of pain interference with goals is that, when people are persistently exposed to pain, they become 'hypervigilant' for pain signals. In other words, as people consistently experience pain, they become more excessively attentive to their pain symptoms or to threats to their body (see Chapman 1978; Van Damme, Legrain, Vogt, & Crombez, 2010 for review). From the evolutionary perspective, pain is regarded as an internal biological signal that alerts one's body to a posed threat. To maximize survival, flexibility is required in modulating one's current goals and behaviors so as to avoid danger or threat (Van Damme, Legrain, Vogt, & Crombez, 2010). Therefore, pain seems to capture attention abruptly due to an internal alarm system. Simultaneously, it interrupts the pursuit of any ongoing goals in order to promptly and flexibly shift attention to the pursuit of more adaptive goals (see Eccleston

& Crombez, 1999; Van Damme, Legrain, Vogt, & Crombez, 2010 for review). As this process continues due to frequent pain occurrence, people learn to react with hypervigilance to their pain experience.

According to pain hypervigilance theory, it seems likely that pain captures attention due to an evolutionarily pre-programmed mechanism. However, a different mechanism, goal shielding, appears to also be playing a role in interference with goal pursuit. Van Damme et al (2010) suggested that attentional bias may possibly be connected to a goal that a person values most. That is, goal shielding occurs when one pursues a highly valued goal. Pursuit of that valued goal can strongly capture one's attention and the pursuit of other goals can be strongly inhibited (Fishbach & Ferguson, 2007; Goschke & Dreisbach, 2008; Shah, Friedman, & Kruglanski, 2002). In fact, goal shielding can function adaptively and positively in dealing with pain. For example, Schrooten and his colleagues' recent study (2012) indirectly supported this idea. They compared attentional bias to pain signals between a non-pain goal group (i.e., instructed to respond to digits as quickly and accurately as possible; participants will gain one point of monetary compensation when they have a quick and accurate response whereas they will lose one point for having a slow and inaccurate response) and a control group (i.e., no instructions for responding to digits were provided). Their findings suggested that when participants were pursuing a non-pain related but salient goal, due to the effect of goal-shielding, they were cognitively less influenced by pain experience. However, in reality, not all chronic pain patients value goals that are pain-unrelated. It seems quite common for people with chronic pain to pursue pain-related goals such as: (a) eliminating the pain; (b) controlling the pain; and (c) finding the cause and solution of their pain

(Eccleston & Crombez, 2007). If one's salient or currently pursued goal is pain-related, this may produce the side-effect of goal shielding. Van Damme et al (2010) provided an excellent example of how maladaptive goal-shielding could happen to pain patients in their everyday lives:

"Think again about the example of the man with back pain. Imagine now that this man has been surgically treated for a hernia the year before. He might interpret the sensations in his back as a re-injury and find this extremely threatening. In this context, adequately dealing with the problem will probably become the central goal. The man will worry about the potential consequences, try to avoid back-stressing behaviours, and carefully monitor further signals of damage in his back. Attentional processing of other information that is not related to the back problem will be inhibited, probably resulting in less efficient task performance at the office."

To summarize, from a cognitive-motivational perspective, pain appears to interfere with pursuit and progress of valued life goals in the following two plausible ways: (1) repeated exposure to pain may lead individuals to develop pain-related hypervigilance which inhibits attention to other important goals and shifts attention to goals that are more pain-preventing; (2) if an individual prioritizes pain-related goals over other meaningful goals, then the progress of those other meaningful goals will likely be hampered because of the activation of goal shielding toward the prioritized pain goal.

## **Affect and Goals**

Both positive and negative emotions seem to exert a considerable influence on the selection of goals and the process of self-regulation (see Hamilton & Karoly, 2004 for a review). For example, Gray (1994) pointed out that negative affect (e.g., sadness, fear, anxiety) stimulates the pursuit of goals that are short-term harm avoidant. However, in the case of positive affect (e.g., amusement, joy, contentment), it is likely that appetitive reward-seeking, long-term goals will be pursued (Fredrickson, 1998; Gray, 1994). Carver and his colleagues (e.g., Carver, Lawrence, & Scheier, 1996; Carver & Scheier, 1990) contend that negative emotions arise from the Behavioral Inhibition System (BIS) which prompts individuals to endorse harm avoidance goals, whereas positive emotions activate the Behavioral Activation System (BAS) which stimulates the appetitive motivational system.

Recently, investigators have examined how affect influences the activation of goal pursuit and commitment towards goals. For example, Custers and Aarts (2005) reported from their six studies that positive affect enhanced people's motivation and effort to accomplish their goals more than neutral or negative affect did. Fishbach and Labroo (2007) also suggested that positive affect increases adoption of accessible goals and, compared to neutral and negative affect, induction of positive affect seems to make people commit and strive more to work towards their goals. Although studies have just begun to examine the impact of affect on the goal pursuit process, it appears that both positive and negative affect can influence goal desirability and attainability. However, as the focus of this proposed study is on investigating how pain intensity impacts on one's goal pursuit and progress, over and above some other important variables that are

associated with this self-regulatory process, both positive and negative affect shall serve as covariates.

### **Individual Differences in Pain Interference with Goals**

Despite the fact that it is important to investigate within-person differences across days with pain experience, individual differences in dealing with pain in terms of the overall goal pursuit process are likely to show a high degree of between person variability. Among the many dispositional differences, pain acceptance and pain catastrophizing may help us to better understand how people adjust to daily pain experience.

#### *Pain Acceptance*

A number of studies by McCracken and his colleagues suggest that people with greater pain acceptance show better physical, emotional, and social functioning, less analgesic medication use, and improved work status (McCracken & Eccleston, 2005; McCracken & Vowles, 2006). In addition to these benefits with higher pain acceptance, some other investigators reported that acceptance of chronic pain is strongly correlated with less pain intensity, psychological distress, depression, pain-related anxiety, and physical and vocational disability (McCracken, 1998; McCracken & Eccleston, 2003; McCracken et al., 1999).

Pain acceptance entails neither ignoring nor diverting attention from pain. In fact, studies have demonstrated that avoiding or controlling pain strategies is actually ineffective for most chronic pain patients (Crombez et al, 2008; McCracken, Vowles, & Eccleston, 2004). McCracken and his colleagues (2004) conceptualize pain acceptance as two components and provide two operational definitions of pain acceptance: (1) the

absence of defense or struggling with potentially uncomfortable experiences (e.g., thoughts and feelings); and (2) in the presence of discomfort engaging in actions towards things that serve important value in life. In other words, contrary to most people's beliefs, individuals who actively engage in meaningful and enjoyable everyday activities and goals in the presence of pain experience are demonstrating 'pain acceptance'. Pain acceptance is the ability to have a symbiotic relationship with pain rather than avoiding it or being distracting by it.

### *Pain Catastrophizing*

Pain catastrophizing is regarded as a stable phenomenon among the chronic pain population and, thus, has been utilized widely as an individual difference measure (Keefe, Brown, Wallston, & Caldwell, 1989; Wade et al., 2011). It is a cognitive factor that has been repeatedly shown to be influential in predicting pain sensation and depression (Linton et al., 2011; Velly et al., 2011; Wood et al., 2013). In addition, it known to serve as one of the main maladaptive cognitive functions of both people who experience acute and chronic pain (Keefe, Brown, Wallston, & Caldwell, 1989; Sullivan et al., 2001; Turner & Aaron, 2001). According to Sullivan and colleagues (2001), pain catastrophizing is identified as having three major components: (1) Rumination— an inclination to immoderately focus on pain sensation; (2) Magnification— magnifying the potential threats caused by pain; and (3) Helplessness— being helpless to control the nociceptive experience. Recent studies explain that these catastrophic misinterpretations (e.g., magnification of pain threat and helplessness) are positively associated with pain-related fear and avoidance (Karsdorp, Ranson, Schroote, & Vlaeyen, 2012; Linton et al., 2011) and predict a higher level of pain and functional disability (Keefe, Brown, Wallston,

& Caldwell, 1989; Vlaeyen & Linton, 2000). It seems plausible that pain catastrophizing may contribute to facilitating a behavioral inhibition system (Carver, Lawrence, & Scheier, 1996; Carver & Scheier, 1990), like the influence of negative affect. Furthermore, it has been consistently reported that the rumination facet of pain catastrophizing shapes chronic pain people to develop inflexible attention shifting from pain-related worry and thoughts (Sullivan, Bishop, & Pivik, 1995). This implies that the individual difference of pain catastrophizing might serve as an important moderator in the relationship between daily pain and the interference with goal pursuit.

One of the problems in using catastrophizing as an individual difference measure for the chronic pain population is whether catastrophizing is a uniquely different factor from some depression symptoms. Previous studies suggest that catastrophizing shares a considerable amount of variance with depression. For example, Jensen and his colleagues (1991) argue that depression and catastrophizing are just 'two sides of the same coin'. However, some other investigators contend that catastrophizing shares only little variance with depression and has a unique role to play over and above depression symptoms (Geisser, Robinson, Keefe, & Weiner, 1994; Leeuw et al., 2007; Sullivan, Bishop, & Pivik, 1995). As this controversy remains, in the proposed study, depression, anxiety and stress were included as covariates so as to examine whether catastrophizing shows a unique prediction for the criterion.

### **Rationale for Using a Non-Clinic-Derived Pain Population**

Rather than sampling a group of clinically referred chronic pain patients, the proposed study is investigating a community sample of adults who report pain almost every day. Even though most chronic pain studies these days focus on a specific pain

population (e.g., fibromyalgia, rheumatoid arthritis, cancer, chest pain, and migraine; see Affleck et al., 1999; Finan, Zautra, Davis, Covault, & Tennen, 2010; Massey, Garnefski, & Gebhardt, 2009; Smith & Zautra, 2008 for review), clinics are not the only locale from which to sample. Karoly and Ruehlman (1996) provide three reasons for the utilization of the non-clinic-derived pain population: (1) in the United States, due to significantly high medical expenses, without proper health insurance many chronic pain patients cannot afford to visit hospitals or clinics in order to receive regular treatment. Therefore, only accessing clinically referred pain patients might lead to sampling bias; (2) clinic-derived chronic pain patients may represent extreme samples of the pain population and, thus, by solely utilizing extreme groups the true relationship between pain and self-regulatory processes may be difficult to discern. In terms of external validity, sampling people with chronic pain from the general population appears to be a better choice; and (3) it has been demonstrated that the majority of clinically diagnosed pain patients suffer from various kinds of psychopathology (e.g., depression, anxiety, personality disorders) and, therefore, these confounding variables can be significant barriers in examining our hypothetical models of pain and the process of self-regulation.

Although the sample for the present study consists of people endorsing pain, as suggested by Karoly and Ruehlman (1996) the emphasis was placed on pain *chronicity*, which is the length of time that an individual has experienced pain. The intensity of pain for the non-clinic-derived pain population might be relatively weaker than that of the clinical pain population. However, based on prior studies of the non-clinic-derived pain population (see Karoly, Okun, Ruehlman, & Pugliese, 2008; Karoly & Ruehlman, 1996; Ruehlman, Karoly, & Newton, 2005 for review), it is assumed that even milder levels of



pain intensity could influence individuals' motivational systems and psychosocial adjustment if the pain is chronic.

### **Daily Diary Study Overview**

Following Affleck et al's (1999) research, the present study met the two main criteria that qualify a daily process study: (1) dependent variables that change on a day-to-day basis should be meaningful and should be repeatedly measured; (2) dependent variables that are measured at within-day intervals.

There are two popular ways to design a daily process study. The first is a time-based diary design. Participants are asked to complete diaries at random, fixed, or a combination of random and fixed times of day. For example, participants enter diaries following random signals from researchers in a random time design. Affleck and his colleagues (2001) used this random time-contingent diary design (i.e., participants were asked to rate their pain and fatigue by following a randomly determined signal between 9:45 and 11:15 a.m.) with fibromyalgia patients. By contrast, in the case of a fixed time diary design, participants are asked to complete diaries at a specific time of day, usually in the evening. For instance, Zaider et al (2010) used a fixed time-contingent design to examine the relationship quality between people who have anxiety disorders and their spouses by asking the participants to make a diary entry at the end of the day. The other popular design is called an event-contingent design. Participants are required to enter diaries whenever an important event occurs (Affleck et al., 1999). For example, Merrilees and her colleagues study (2008) investigated marital conflict change by asking the participants to complete diaries right after an argument occurred. The current study uses a

random time-based diary design in which participants were asked to complete a diary entry at three random times of day, in the morning, afternoon and evening.

### **Strengths of the Day Process Approach with Multi-Level Modeling**

There are several benefits in using multi-level modeling in analyzing a within-day process design. First, this approach provides researchers with many different options to analyze data and answer questions. For example, multi-level modeling makes it possible for researchers to investigate not only between-person differences but also within-person differences (e.g., higher pain intensity during the day predicts less positive affect at night) that might be invaluable for researchers to investigate (Affleck, Zautra, Tennen, & Armeli, 1999; Bolger et al., 2003). Another interesting question that can be addressed with a daily process design is whether within-person daily processes can differ by individuals. This is called a cross-level interaction. Following Kreft, deLeeuw, and Aiken's study (1995), using the person-mean centering (i.e., subtracting the mean of each individual) approach, researchers can clearly separate within-person and between-person variance, thus allowing them to examine how trait differences between individuals (e.g., level 2 in the multi-level model) impact within-person processes (e.g., level 1 in the multi-level model). Cross-level interactions can add idiographic information to nomothetic inquiry (Affleck, Zautra, Tennen, & Armeli, 1999).

Second, this approach enables researchers to establish temporal precedence and, thus, increase the validity of causal inference Affleck, Zautra, Tennen, & Armeli, 1999; Tennen & Affleck, 1996). Since diaries are collected for a short period of time (e.g., three or four weeks), researchers will be able to examine whether a preceding variable (e.g.,

negative affect in the morning) predicts a criterion variable measured later time (e.g., pain intensity at night).

Third, the approach significantly reduces recall bias (Affleck, Zautra, Tennen, & Armeli, 1999). Self-report is the most typical method for collecting data in most studies due to its simplicity and cost-effectiveness. However, one of the major drawbacks of using self-report is its retrospective nature. Participants are asked to recall their experiences or feelings that occurred in the past, such as the last week, month, or year (Hufford & Shiffman, 2003). As Hufford and Shiffman (2003) point out, this leads to the problem of recall bias which causes a significant error and decreases the reliability of participants' responses to the questionnaires that ask about events or experiences from the past. The daily diary method, however, significantly reduces this recall bias and increases the reliability of measurement (Tennen & Affleck, 1996). Especially, in the case of an event-contingent daily diary design, since participants are asked to complete the questionnaires right after the event occurs, the gap in recalling one's experience, event or feeling dramatically decreases. Even though an event-based diary design might be one of the best ways to deal with recall bias, a time-contingent design will still enable investigators to control recall bias.

Last, the daily process approach provides researchers with the opportunity to capture spontaneous changes in daily processes and the occurrences of important events or feelings (Affleck, Zautra, Tennen, & Armeli, 1999; Bolger et al., 2003). In other words, contrary to laboratory experiments or both cross-sectional and longitudinal self-report based studies, daily diary can capture natural events or feelings that are experienced by

individuals in everyday relationships. Hence, generalizability (e.g., external validity) increases with use of this method.

### **The Proposed Study**

The current study examines the within-day process of pain on work- and lifestyle goal progress in a multi-level framework. Some previous studies (Affleck et al, 1998; 2001) have attempted to demonstrate how pain and fatigue are associated with daily progress and effort made toward health and social goals in female fibromyalgia patients through daily process analysis. However, to our knowledge, no researchers have investigated the within-day sequential mechanism of how pain level at the beginning of day influences later in the day work- and lifestyle goal accomplishment. Our model includes pain interference of work- and lifestyle goal pursuit as a mediator and two between-person variables, pain acceptance and catastrophizing, as moderators of the relationship between pain intensity and work- and lifestyle goal pursuit. We anticipate that this sequential within-day process model with a mediator and moderators will make a unique contribution by demonstrating how and for whom pain distracts self-regulatory process in the chronic pain population. Specific hypotheses are described below.

#### *Hypothesis 1*

Based on previous findings on pain and pain interference with goals (i.e., attentional bias; Van Damme, Legrain, Vogt, & Crombez, 2010), it is expected that experiencing more than usual pain in the morning will predict pain interference with work- and lifestyle goal pursuit in the afternoon while controlling for both morning positive and negative affect.

### *Hypothesis 2*

It is assumed that pain acceptance and catastrophizing, which are between-person differences, can moderate the relationship between pain intensity in the morning and pain interference with work- and lifestyle goal pursuit in the afternoon. More specifically, pain acceptance is anticipated to attenuate the within-person relationship between pain and goal interference, whereas pain catastrophizing is expected to magnify this within-person relationship (i.e., strengthen the relationship between the two). To examine the unique moderation effect of pain acceptance and catastrophizing, the DAAS total score (depression, anxiety and stress) was included as a covariate.

### *Hypothesis 3*

It is expected that more than usual afternoon pain interference with work- and lifestyle goal pursuit will produce a decrease in evening work- and lifestyle goal progress over and above morning pain intensity and positive and negative affect.

### *Hypothesis 4*

It is expected that afternoon pain interference with work- and lifestyle goal pursuit will mediate the relationship between morning pain intensity and evening goal progress. However, mediated effects will vary across levels of pain acceptance and pain catastrophizing.

## **METHOD**

The present study was conducted as a secondary data analysis based upon a larger data set some of which was previously published by Karoly, Okun, Enders, and Tennen (In press).

## **Participants**

The sample for the current study was recruited by the Behavior Research Center of Phoenix, Arizona. Using computer-based random-digit dialing, residents within approximately 20 miles of the research facility in the Phoenix metropolitan area received phone calls. Then, the telephone interviewers screened the residents who answered the phone calls based on a screening script that was developed by the experimenters. To participate in the study, participants had to meet several criteria, including: (1) be at least 25 years old but less than 70 years old, (2) have experienced physical pain for the past six months almost every day, (3) have the ability to read English at a minimum third grade level, (4) not be color blind, (5) work either paid full-time or paid part-time during the day, (6) reported not using illegal substances (e.g., marijuana, LSD, heroin, cocaine, etc) in the past 12 months, and (7) be able to complete the diary by phone call three times a day for 21 days. In addition to the phone based screening, those selected participants had to go through another screening process using a self-report 4-item chronic pain severity questionnaire which total scores range from 0 to 30. Cut off scores for inclusion in the study were determined separately by age and sex based upon Ruehlman et al's (2005) national study using this pain severity questionnaire.

After the completion of these screening procedures, 318 adults were eligible to participate in the study. However, among them 155 subjects (48.7 percent) declined to participate. The remaining 163 participants who agreed to participate received another phone call from the Behavior Research Center and were scheduled for a laboratory appointment at the research facility in Phoenix. The appointments for the laboratory study took place between May 2010 and March 2011. Sixteen participants (9.8 percent) never

showed up to any scheduled appointments (even for subsequent scheduled appointments). Among 147 subjects who showed up for their initial assessments, 16 (10.9 percent) were found to be ineligible to participate in the study for the following reasons: they were (a) not currently working, (b) unable to articulate an important work goal, or (c) not able to complete phone-based diaries 3 times a day for 21 days. Hence, the final sample for the current study consists of 131 participants.

To examine the potential threat of sampling bias the final sample chosen for the present study, potential subjects who declined to participate, who did not show up to initial appointments, and those who were disqualified from participation were compared using one-way ANOVAs. The dependent variables (age and chronic pain severity screen score) were continuous and for the categorical dependent variables (sex, race, ethnicity, and zip code) chi-square tests were used. The ANOVA and chi-square test results show that the difference in participant status (final participants of the current study, decliners, no shows, and those ineligible) on age, chronic pain severity screen scores, gender, race (Hispanic versus Non-Hispanic), ethnicity (White versus Other Single Ethnicities Combined, versus Two or More Ethnicities), and zip code (Phoenix versus Mesa versus Tempe) were not statistically significant. These data support the representativeness of the final sample of the study.

## **Procedure**

All procedures for data collection in the current study were approved by the Institutional Review Board at Arizona State University prior to initiating the study. Also, written informed consent was obtained from the participants beforehand. Participants were paid separately for two different types of data collection: (a) \$45 for participating in

a 150 minute lab visit (initial lab appointment); and (2) up to \$155 if almost all diaries for 21 days were completed. Participants during the lab visit received a thorough explanation of the special features of the interactive voice response (IVR) system used for collection of diary data. For example, participants were told that they would receive a 5-minute phone call via the IVR system three times a day for 21 consecutive days, for a total of 63 calls. If they missed a call, they were asked to call back during the fixed time window to complete the diary. After the explanation, participants had to go through a mandatory face-to-face training session on how to complete IVR system based diary. Research staff explained the required time windows for placing the morning (6:00 to 10:00 AM), afternoon (noon to 4:00 PM), and evening calls (7:00 to 11:00 PM). Note that an afternoon call represents the time period from when the last morning call made to when an afternoon call was received. Thus a daily diary measure that was collected in this period of time is marked as "afternoon \_\_\_\_". In the case of an evening call, this indicates the time period from when the last afternoon call was made to when a evening call was received. Therefore, a diary measure that was collected in this period of time is called as "evening \_\_\_\_". During the trial session, participants took part in an automated interview answering the questions via the telephone number pad. Participants were also shown the scripts for diary interview which contains all the questions for each time of the day. The practice session continued until participants expressed that they are confident in using the IVR system. After the session was over, research staff members conducted goals elicitation interviews with the participants.

Staff members asked participants to provide lists of important work- and lifestyle goals. Work- and lifestyle goals are each respectively defined as follows: (a) "a personally



valued outcome toward which effort is consistently directed while you are on the job"; (b) "things that make your life better such as goals for physical health, mental health, social relationships, intellectual pursuits, hobbies, recreation, spirituality, or community service". There were several criteria used for listing important work- and lifestyle goals: each goal had to be (a) highly valued, (b) realistically obtainable, (c) concrete and measurable, and (d) pursued almost every day for the next 21 days. Among the lists that they came up with, participants were asked to select a single work goal and lifestyle goal that is most important to them. After the most important goal was identified by the participants, they moved on the next half of the study. In order to collect between-person data (i.e., level-2, in the multi-level model), a total of 207 questions were answered that included demographics, personality measures, pain experiences and goal behaviors. After completing these, participants were then asked to perform a set of cognitive tasks (e.g., the Stroop test, the Wisconsin Card Sort, and several others) and respond to questionnaires that were associated with these tasks. The order of the cognitive task experiment was administered in random order by research staff.

As the final portion of the lab visit, participants were provided with an information packet which contains detailed instructions for completing the IVR system-based diary calls, a copy of the script used for the diary interview, and a card with the IVR phone number, details about the log-in procedure and participant-identified work- and lifestyle goals that are all essential to placing diary calls if they happen to miss a call.

#### *IVR Technology*

IVR technology was hosted by the University of Connecticut Health Center. The IVR technology provides a combination of telephone service with computer-administered

questionnaires. The system was interfaced with local area network stations for data input, storage, and backup. The brief procedure for IVR technology data collection is as follows: (1) participants receive a phone call from the IVR system with a toll-free number and participants enter their identification number; (2) by pressing a number on the keypad of their telephones (0 to 9), participants can answer the computer-administered diary questionnaires.

IVR system activities and the participants of the present study were monitored by research staff. When a participant missed several calls in a row, the staff members were asked to provide friendly reminder calls to the participants. A short note of appreciation for their participation was sent by mail to participants who completed the first 14 days of the 21-day diary procedure. Across, all occasions and days, participants, on average, completed 89.5% of the phone calls.

#### *Chronic Pain Severity Screen*

In order to recruit a target sample, the Profile of Chronic Pain (PCP) Screen Severity Scale was administered twice—once during telephone recruitment and again during the lab visit. There was approximately a 7-days interval between the two assessments. The PCP-Screen Severity Scale consisted of four questions (Ruehlman et al., 2005): (1) “Over the past 6 months, how often did you have this pain” with response options ranging from 0 (never) to 6 (daily)?” (2) “What was your AVERAGE level of pain on days when you had pain during the past six months, where zero means very little pain and nine means unbearable pain?” (3) “How often during the PAST 6 MONTHS have you had at least one hour’s worth of pain that hinders you from accomplishing your daily tasks with response options ranging from 0 (never) to 6 (daily)?” and (4) “What was

the GREATEST amount of pain you have had over the PAST 6 MONTHS, where zero means very little pain and nine means unbearable pain?” The test-retest correlation for the PCP-Screen Severity scores was .68. The mean of the screen score was 22.33 ( $SD = 4.28$ ) at the first administration and 21.98 ( $SD = 3.89$ ) at the second administration. The mean pain severity scores were not different over time,  $t(129) = 1.19, p > .05$ . The internal consistency reliability as indexed by Cronbach's  $\alpha$ , for the PCP-Screen Severity subscale was .69.

### *Demographics*

The final sample of 132 participants included 61% female and 39% male. The mean age of the participants was 49.49 years old ( $SD = 11.99$ ). The sample consisted of participants from diverse ethnic backgrounds (80% Caucasian, 4% African American, 2% Native American, 2% Asian, 7% mixed race, and 5% other). It was also found that 18% of the sample reported themselves as being of Hispanic origin. The sample of participants was varied in marriage status (53% were married, 23% were single, 18% were divorced, 3% were widowed and 3% were not married but living together with their spouse). In the case of employment status, the majority of the participants were working full-time (74%). Last, education backgrounds also varied by participants (49% had some college or had earned an Associate's degree, 16% had a Bachelor's degree, 24% had a graduate or professional school degree, and the remaining 7% had a high school diploma or less education).

## Measures

### *Goal Content*

Participants reported various types of work- and lifestyle goals. Overall, work goals were divided into either task-oriented or interpersonally-oriented goals. The content of lifestyle goals was also varied, including self improvement, social interaction, spirituality, recreation and so on. However, these goals were not categorized due to the heterogeneity of goal types.

### *Daily Diary Measures*

*Pain Intensity:* Participants answered the following question that assesses morning pain intensity: “If a zero means no pain, and nine means pain as bad as it could be, on a scale from 0-9, what is your level of pain right now?”

*Positive Affect:* Morning positive affect was measured with four items. Of the four, alert and enthusiastic, were chosen from the PANAS (Watson & Clark, & Tellegen, 1988) and the other two, happy and relaxed, were selected due to their relevancy to people with chronic pain. Participants were asked to rate the intensity of each positive affect that they might have felt over the past 30 minutes using a scale ranging from 0 (not at all) to 9 (extremely). A morning positive affect score was calculated as the average ratings of the four items.

*Negative Affect:* Negative affect was also asked with four items. Two of the items, nervous and upset, were drawn from the PANAS (Watson & Clark, & Tellegen, 1988) and the remaining two items, angry and fearful, were chosen for the same reason mentioned above. Participants were asked to rate the intensity of each negative affect that they felt over the past 30 minutes using a scale ranging from 0 (not at all) to 9

(extremely). A morning negative affect score was calculated as the average ratings of the four items.

*Pain Interference of Work- and Lifestyle Goal Pursuit:* To measure pain interference of work [lifestyle] goals in the afternoon, participants were asked to rate how much their pain interferes with their ability to effectively pursue their work goal using a scale that ranges from 0 (not at all) to 9 (extremely). It should be noted that before participants were asked to rate pain interference they first responded to another item called "Goal Pursuit", where they were asked whether or not they pursued their work- and lifestyle goals in the afternoon. Only participants who said that they had pursued their goals (both work and lifestyle) in the afternoon rated pain interference.

*Work- and Lifestyle Goal Progress:* Work- and lifestyle goal progress was measured in the evening diary by asking participants the following: "How much progress have you made on your work [lifestyle] goal today since the last time we talked with you?" For this question, participants indicated their evening work [lifestyle] goal progress using a scale that ranges from 0 (none at all) to 9 (quite a lot). Although the measure was named as evening goal progress, this does not mean that the participants actually made "evening" goal progress. Their answers are in fact based on afternoon goal progress. In addition, identical to the pain interference with goal pursuit diary measure, before participants were asked to rate their evening progress, they first responded to another item called "Goal Pursuit", that again asked whether they pursued their work- and lifestyle goals in the evening. Only participants who said that they had pursued their goals (both work and lifestyle) in the evening rated their goal progress.

## **Individual Difference Measures**

*Pain Acceptance:* Pain acceptance was measured by a 20-item self-report Chronic Pain Acceptance Questionnaire (CPAQ; McCracken, Vowles, & Eccleston, 2004;). CPAQ has a rating scale that ranges from 0 (Never) to 6 (Always) and is comprised of two reliable and valid subscales. The activity engagement subscale is comprised of 11 items that measure how much one pursues life activities while having pain (e.g., "I lead a full life even though I have chronic pain"). The other subscale is pain willingness which consists of 9 items that assess the extent to which an individual is willing to experience pain without trying to control it (e.g., "I need to concentrate on getting rid of my pain"). A higher total score represents higher pain acceptance. Cronbach's alpha of activity engagement was .83, pain willingness was .81 and CPAQ total was .88.

*Pain Catastrophizing:* Pain catastrophizing was measured using the Pain Catastrophizing Scale (PCS; Sullivan, Bishop, & Pivik, 1995). PCS consists of 13 items rated on a 5-point Likert scale ranging from 0 (not at all) to 4 (all the time) and measures catastrophic thinking in response to pain. PCS is formed by three subscales: Rumination, Magnification and Helplessness. Examples of items for each subscale are: "I keep thinking about how badly I want the pain to stop" (Rumination); "I become afraid that the pain may get worse" (Magnification); and "There is nothing I can do to reduce the intensity of the pain" (Helplessness). The total score of PCS ranges from 0 to 52 and higher PCS scores indicate greater pain catastrophizing. The Cronbach's alphas for total and subscales of PCS in the present study are: PCS-Total .90; PCS-Rumination, .85; PCS-Magnification, .63; and PCS-Helplessness, .83).

*Depression, Anxiety and Stress:* Depression, anxiety and stress were measured using the Depression Anxiety Stress Scales (DASS; Lovibond & Lovibond, 2002). Each item is rated on 4-point Likert scale ranging from 0 (Never) to 3 (Almost Always). It consists of three subscales that assess depression, anxiety, and stress. Examples of items for each subscale are: "I couldn't seem to experience any positive feeling at all" (Depression); "I experienced trembling (e.g., in the hands)" (Anxiety); and "I tend to over-react to situations" (Stress). All three subscales have been shown to have great reliability and convergent and discriminant validity (Crawford & Henry, 2003). The range of possible scores for each subscale is between 0 to 21. The original DASS is comprised of 42 items and a shortened version of DASS consists of 21 items. The 21-item shortened version of DASS was administered in the current study. It has been reported that this version has a cleaner factor structure and smaller inter-factor correlations than the original 42-item DASS (Antony et al, 1998). The Cronbach's alphas for depression, anxiety and stress subscales were .89, .79, and .84, respectively. Since all three subscales of DASS were highly correlated, the total mean score of DASS was used in the present study.

## **RESULTS**

### **Data Analysis**

Multilevel Modeling (Hierarchical Linear Modeling) was used to examine the hypothesized model described above. Mplus version 7 (Muthén & Muthén, 2012) was used to estimate a series of multilevel models.

## **Preliminary Analysis**

Mean and standard deviation were calculated for each of the day-level (Level-1) measures throughout the 21-day period for each participant and person-level measures (Level-2). The summary of these findings is depicted in Table 1. The intercorrelations of day-level variables (all person-mean centered) as well as person-level and outcome variables were also calculated. Results of these correlations are presented in Table 2 and Table 3. Table 2 shows that most of the intercorrelation between daily measures was significant except all morning predictors (i.e., pain intensity, positive and negative affect) were not significantly correlated with goal progress measures. This result suggests that there might non-significant direct effect from predictors to outcome variables. As there were low-to-moderate correlations between all variables, it appears that the possibility of multicollinearity is mitigated in the multivariate analyses using a set of level-1 predictors. Table 3 reveals the intercorrelations between level-2 variables and level-1 outcome variables. The pain acceptance variable was moderately correlated with the pain catastrophizing variable. DASS total mean score was also found to be moderately correlated with both pain catastrophizing and acceptance variables. The correlation between all level-2 variables and goal progress day-level outcome variables was found to be non-significant.

## **Within- and Between-Person Variability in Daily Diary Measures**

Before constructing the proposed multilevel models, unconditional models which do not include any predictors were estimated for the continuous outcomes. This particular process was employed because it provides important information how the variation in ratings is partitioned into within- and between-person variability. The result showed that



the intraclass correlations (ICCs) for the all day-level variables were ranging between .44 and .54. For example, 54% of the variation in pain interference with work goal pursuit and 47% of the variation in work goal progress was explained by between-person differences. Table 1 presents the within- and between person variability in daily diary measures that were used in the present study. These statistical outcomes suggest that there are substantial variations at both within- and between-person levels of the data hierarchy. Therefore, it seems appropriate to estimate models with both levels of the predictors of pain interference with goal pursuit and goal progress.

### **Centering**

Both level-1 and level-2 predictors were centered for two specific reasons. First, in the case of centering level-1 variables, it was expected that daily score values would depend on other scores of the same cluster (i.e., person). For example, the interpretation of any daily pain score (e.g., a rating 4 out of 9) depends on the overall mean of his or her daily pain ratings (that is, a score of 4 is low if the person is 8, but is high if the person mean is 2). In short, it is a state-like variation, and thus person-mean centering was used for level-1 predictors. In the case of level-2 variables, grand-mean centering was used because the interpretation of score values does not depend on other scores of the same cluster. It is a trait-like variation. Second, by centering the level 1 and level 2 predictors, the relationship between them becomes orthogonal. To be specific, the level-1 predictors were centered at the person means (Enders & Tofighi, 2007) by subtracting each individual's average rating for a variable from the daily rating. In the case of level-2 predictors, they were grand mean centered. Each individual's rating was subtracted from the mean of all the individuals. Through this strategy, the person mean centered level-1

variables are uncorrelated with grand mean centered level-2 variables and thus, the present study can assess an unique influence of a variable at each level. This centering strategy was used for all models.

### Overview of Multilevel Models

A random intercept multilevel model for afternoon pain interference of "work goal" pursuit as outcome was estimated first by including daily ratings of morning pain, morning positive affect and negative affect as level-1 predictors. The equation for this model is as follows:

$$APIWGP_{ij} = \beta_0 + \beta_1(Pain_{ij}) + \beta_2(PA_{ij}) + \beta_3(NA_{ij}) + b_{0j} + b_{1j}(Pain_{ij}) + b_{3j}(NA_{ij}) + e_{ij} \quad (1)$$

*Note.* APIWGP = Afternoon Pain Interference of Work Goal Pursuit, Pain = Morning Pain, PA = Morning Positive Affect, NA = Morning Negative Affect

In this model,  $Y_{ij}$  is the outcome score at day  $i$  for person  $j$ ,  $\beta_0$  is the conditional mean of afternoon pain interference of work goal pursuit ratings for days where persons are at their average of the level-1 variables,  $\beta_1$  is the coefficient for the within-person morning pain predictor,  $\beta_2$  is the coefficient for the morning positive affect predictor,  $\beta_3$  is the coefficient for the morning negative affect predictor,  $b_{0j}$  is a random intercept that captures between-person variation in the outcome means, and  $e_{ij}$  is the level-1 residual. We also investigated whether the influence of the level-1 predictors varied across persons. To do so, we estimated the model in Equation 1 three times, each

time adding a random slope for one of the predictors. Likelihood ratio tests from restricted maximum likelihood estimation revealed that daily morning pain ratings,  $\chi^2(2) = 21.712, p < .001$  and morning negative affect scores,  $\chi^2(2) = 11.810, p < .01$ , required a random slope (i.e., the association between afternoon pain interference of work goal pursuit and morning pain varied across persons).  $b_{1j}$  and  $b_{3j}$  are the random slopes for the level-1 predictors.

The next model includes level-2 predictors on top of level-1 predictors only model so as to investigate between-person effects. The model that includes both level-1 and level-2 predictors is given in Equation 2:

$$\begin{aligned} APIWGP_{ij} = & \beta_0 + \beta_1(Pain_{ij}) + \beta_2(PA_{ij}) + \beta_3(NA_{ij}) + \beta_4(Accept_j) \\ & + \beta_5(Catastro_j) + \beta_6(DASS_j) + b_{0j} + b_{1j}(Pain_{ij}) + b_{3j}(NA_{ij}) \\ & + e_{ij} \end{aligned} \quad (2)$$

*Note.* Accept = Pain Acceptance, Catastro = Pain Catastrophizing, DASS = Depression, Anxiety and Stress Total Score

In this model, the intercept quantifies the expected value (conditional mean) of afternoon pain interference with work goal pursuit for days where persons are at their average of the level-1 variables and at the grand mean of level-2 variables.  $\beta_1$  is the coefficient for the within-person morning pain predictor with average pain acceptance, pain catastrophizing and DASS total score.  $\beta_2$  is the coefficient for the morning positive affect predictor with average pain acceptance, pain catastrophizing and DASS total score,  $\beta_3$  is the coefficient for the morning negative affect predictor with average pain

acceptance, pain catastrophizing and DASS total score,  $\beta_4$  is the coefficient of between-person pain acceptance predictor for someone at their own mean for their pain, positive affect and negative affect.  $\beta_5$  is the coefficient of the pain catastrophizing predictor for someone at their own means of their pain, positive affect and negative affect.  $\beta_6$  is the coefficient of DASS (Depression, Anxiety, Stress) control variable.  $b_{0j}$  is a random intercept that captures between-person variation in the outcome means, and  $e_{ij}$  is the level-1 residual.

The final model investigates cross-level interactions. Cross-level interaction terms were included in the previous baseline model (Equation 2). For the afternoon pain interference of work goal pursuit, the final model is given in Equation 3:

$$\begin{aligned} APIWGP_{ij} = & \beta_0 + \beta_1(Pain_{ij}) + \beta_2(PA_{ij}) + \beta_3(NA_{ij}) + \beta_4(Accept_j) \\ & + \beta_5(Catastro_j) + \beta_6(DASS_j) + \beta_7(Pain_{ij})(Accept_j) \\ & + \beta_8(Pain_{ij})(Catstro_j) + b_{0j} + b_{1j}(Pain_{ij}) + b_{3j}(NA_{ij}) + e_{ij} \end{aligned} \quad (3)$$

In this model, the intercept, residuals and regression coefficients from  $\beta_1$  from  $\beta_3$  have the same interpretation as those from Equation 2.  $\beta_4$  is the coefficient of between-person pain acceptance predictor for someone at their own means of their pain and grandmean of pain catastrophizing.  $\beta_5$  is the coefficient of pain catastrophizing predictor for someone at their own means of their pain and grand mean of pain acceptance.  $\beta_6$  is the regression coefficient of DASS (Depression, Anxiety, Stress) control variable.  $\beta_7$  is the coefficient of the cross-level interaction between within-person

morning pain rating and between-person pain acceptance,  $\beta_8$  is the coefficient of the cross-level interaction between within-person morning pain and between-person pain catastrophizing.

Turning toward the afternoon pain interference with "lifestyle goal" pursuit as our outcome, the baseline model was first estimated by including only level-1 predictors. Equation 3 is as follows:

$$APILGP_{ij} = \beta_0 + \beta_1(Pain_{ij}) + \beta_2(PA_{ij}) + \beta_3(NA_{ij}) + b_{0j} + b_{1j}(Pain_{ij}) + e_{ij} \quad (4)$$

*Note.* APILGP = Afternoon Pain Interference of Lifestyle Goal Pursuit

In this equation, all regression coefficients and the residuals have the same interpretation as those from Equation 1, except that  $\beta_0$  is the grand mean of afternoon pain interference of lifestyle goal pursuit, and morning pain was entered as random slope because Likelihood ratio tests from restricted maximum likelihood estimation revealed that only daily morning pain ratings,  $\chi^2(2) = 10.340, p < .01$  required a random slope. It is represented by  $b_{1j}$  in the equation.

Based on the level-1 predictor only model (Equation 4), between-person effect was tested by including level-2 predictors in Equation 5:

$$\begin{aligned} EAPILGP_{ij} = & \beta_0 + \beta_1(Pain_{ij}) + \beta_2(PA_{ij}) + \beta_3(NA_{ij}) + \beta_4(Accept_j) \\ & + \beta_5(Catastro_j) + \beta_6(DASS_j) + b_{0j} + b_{1j}(Pain_{ij}) + e_{ij} \end{aligned} \quad (5)$$

In this equation, all level-1 and level-2 regression coefficients and the residuals have a similar interpretation as those from Equation 2, except in this model, only morning pain rating was found to be required a random slope.

The full model was constructed for afternoon pain interference with lifestyle goal pursuit as the outcome by adding the two interaction terms same as Equation 3. Equation 6 is as follows:

$$\begin{aligned} EAPILGP_{ij} = & \beta_0 + \beta_1(Pain_{ij}) + \beta_2(PA_{ij}) + \beta_3(NA_{ij}) + \beta_4(Accept_j) \\ & + \beta_5(Catastro_j) + \beta_6(DASS_j) + \beta_7(Pain_{ij})(Accept_j) \\ & + \beta_8(Pain_{ij})(Catstro_j) + b_{0j} + b_{1j}(Pain_{ij}) + e_{ij} \end{aligned} \quad (6)$$

In this equation, all level-1 and level-2 regression coefficients and the residuals have the same interpretation as those from Equation 3, except in this model, only morning pain rating was found to require a random slope.

Next, turning to evening work goal progress as the outcome, a series of level-1 predictors were entered to first construct a baseline model. The model is given in Equation 7.

$$\begin{aligned} EWGP_{ij} = & \beta_0 + \beta_1(APIWGP_{ij}) + \beta_2(Pain_{ij}) + \beta_3(PA_{ij}) + \beta_4(NA_{ij}) \\ & + b_{0j} + b_{2j}(Pain_{ij}) + b_{3j}(PA_{ij}) + e_{ij} \end{aligned} \quad (7)$$

*Note.* EWGP = Evening Work Goal Progress, APIWGP = Afternoon Pain Interference of Work Goal Pursuit

In this model,  $\beta_0$  is the conditional mean of evening work goal progress ratings for days where persons are at their average of the level-1 variables,  $\beta_1$  is the regression coefficient for the afternoon pain interference of work goal pursuit,  $\beta_2$  is the coefficient for the morning pain predictor,  $\beta_3$  is the coefficient for the morning positive affect predictor and  $\beta_4$  is the coefficient for negative affect predictor.  $b_{0j}$  is a random intercept that captures between-person variation in the outcome means, and  $e_{ij}$  is the level-1 residual. Likelihood ratio tests from restricted maximum likelihood estimation revealed that daily morning pain ratings,  $\chi^2(2) = 8.310, p < .05$  and morning positive affect scores,  $\chi^2(2) = 18.882, p < .001$ , required a random slope, which means that the association between morning pain intensity and evening work goal progress, and the association between morning negative affect and evening work goal progress varied across people. These random slopes are denoted by  $b_{2j}$  and  $b_{3j}$ , respectively.

In order to construct the final model that examines both within- and between-person effects, level-2 predictors were included in the baseline models. The final model is as follows:

$$\begin{aligned}
 EWGP_{ij} = & \beta_0 + \beta_1(APIWGP_{ij}) + \beta_2(Pain_{ij}) + \beta_3(PA_{ij}) + \beta_4(NA_{ij}) \\
 & + \beta_5(Accept_j) + \beta_6(Catastro_j) + \beta_7(DASS_j) + b_{0j} \\
 & + b_{2j}(Pain_{ij}) + b_{3j}(PA_{ij}) + e_{ij}
 \end{aligned} \tag{8}$$

In this model, the intercept quantifies the expected value (conditional mean) of evening work goal progress for days where persons are at their average of the level-1

variables and at the grand mean of level-2 variables.  $\beta_1$  is the coefficient for the within-person afternoon pain interference with work goal pursuit predictor, with average pain acceptance, pain catastrophizing and DASS total score.  $\beta_2$  is the coefficient for the within-person morning pain predictor with average pain acceptance, pain catastrophizing and DASS total score.  $\beta_3$  is the coefficient for the morning positive affect predictor with average pain acceptance, pain catastrophizing and DASS total score,  $\beta_4$  is the coefficient for the morning negative affect predictor with average pain acceptance, pain catastrophizing and DASS total score,  $\beta_5$  is the coefficient of between-person pain acceptance predictor for someone at their own means of their pain, positive affect and negative affect.  $\beta_6$  is the coefficient of pain catastrophizing predictor for someone at their own means of their pain, positive affect and negative affect.  $\beta_7$  is the coefficient of DASS (Depression, Anxiety, Stress) control variable.  $b_{0j}$  is a random intercept that captures between-person variation in the outcome means, and  $e_{ij}$  is the level-1 residual.

Finally, a model based on evening lifestyle goal progress as outcome was constructed. For evening lifestyle goal progress, the baseline model is given in Equation 9.

$$ELGP_{ij} = \beta_0 + \beta_1(APILGP_{ij}) + \beta_2(Pain_{ij}) + \beta_3(PA_{ij}) + \beta_4(NA_{ij}) + b_{0j} \quad (9)$$

$$+ b_{3j}(PA_{ij}) + e_{ij}$$

*Note.* ELGP = Evening Lifestyle Goal Progress, APILGP = Afternoon Pain Interference of Lifestyle Goal Pursuit

The interpretation of all regression coefficients and the residuals are almost identical to Equation 7. Again, we entered random slopes one at a time and verified that



morning positive affect predictor required random effects,  $\chi^2(2) = 16.572, p < .001$ , and it is denoted by  $b_{3j}$ .

We tested the final model of evening lifestyle goal progress as outcome and the equation is as follows:

$$ELGP_{ij} = \beta_0 + \beta_1(APILGP_{ij}) + \beta_2(Pain_{ij}) + \beta_3(PA_{ij}) + \beta_4(NA_{ij}) + \beta_5(Accept_j) + \beta_6(Catastro_j) + \beta_7(DASS_j) + b_{3j}(PA_{ij}) + e_{ij} \quad (10)$$

The interpretation of each regression coefficient is identical to Equation 8 except  $\beta_1$  indicates the regression coefficient of afternoon pain interference of lifestyle goal pursuit with average pain acceptance, pain catastrophizing and DASS total score and  $b_{3j}$  indicates a random slope of morning positive affect.

### **Assessment of Mediation**

To answer the research questions regarding the mediating effects of pain interference with goal pursuit (both work- and lifestyle goal) on the relationship between morning pain intensity and evening goal progress, PRODCLIN (distribution of the PRODUct Confidence Limits for Indirect Effects; MacKinnon, Lockwood, & Williams, 2004) software was used. MacKinnon and his colleagues have continuously demonstrated through simulation studies that asymmetric confidence limits for the distribution of the product provide higher statistical power and more adequately controls Type I error rates than the symmetric confidence limits for the distribution of the product (MacKinnon et al.,

2002; MacKinnon et al., 2004). PRODCLIN software is based on asymmetric confidence intervals, and thus provides more accurate assessment of a mediated effect. The observed values for  $\alpha$ ,  $\beta$ , standard error of  $\alpha$ , standard error of  $\beta$ , correlation between  $\alpha$  and  $\beta$ , and Type 1 error rate are entered in the program and it calculates 95% the upper and lower confidence intervals for the mediated effect. Following PRODCLIN's result, the significance of the mediating effect can be determined if zero was not included in the 95% interval of the upper and lower confidence limits.

*The Afternoon Pain Interference With Work-Goal Pursuit Model (Equation 1 - 3)*

Table 6 gives the parameter estimates, standard errors and  $t$  tests from the baseline model (i.e., only level-1 predictors were included) of analysis. As shown in Table 4, compared to the unconditional model, the level-1 predictors reduced the within-cluster variance from 2.58 to 2.11 (a 18.2% reduction). The results show that there was a significant positive coefficient for morning pain intensity, which means that when a participant experienced greater than usual morning pain intensity, he or she reported more afternoon pain interference of work goal pursuit ( $p < .001$ ) over and above morning positive and negative affect. On the other hand, morning positive affect was found to be a significant negative within-person predictor ( $p < .05$ ), which indicates that days with greater than average positive affect in the morning, people reported less pain interference of work goal pursuit scores in the afternoon.

Table 7 provides parameter estimates, standard errors and  $t$  tests from the analysis of the model which includes all level-1 and level-2 predictors. As shown in Table 4, compared to the baseline model presented above, the level-2 predictors reduced the between-cluster variance from 3.09 to 2.12 (a 31.4% reduction). The overall results of

level-1 coefficient were similar to baseline model. Both morning pain ( $p < .001$ ) and positive affect ( $p < .05$ ) were found to be statistically significant level-1 predictors. Turning to the level-2 coefficients in Table 4, notice that only pain acceptance was a significant negative level-2 predictor ( $p < .001$ ), meaning that after controlling for pain catastrophizing and DASS total mean score, relative to participants with lower pain acceptance ratings, participants with higher pain acceptance ratings were less likely to report daily pain interference of work goal pursuit in the afternoon.

Table 8 also provides parameter estimates, standard errors and  $t$  tests from the analysis of the final model that includes the level-1, level-2 predictors and cross-level interaction terms. In order to test whether the two cross-level interaction terms provide unique effect over the model with only level-1 and level-2 predictors,  $-2\log\text{Likelihood}$  was compared. Likelihood ratio tests from restricted maximum likelihood estimation revealed that the final model ( $-2\text{LogLikelihood} = 4694.834$ ) provided a marginal improvement fit over the model with only level-1 and level-2 predictors ( $-2\text{LogLikelihood} = 4700.398$ ;  $\chi^2(2) = 5.56, p = 0.06$ ). Again, how much within- and between-cluster variance were reduced from the baseline model was calculated. The level-1 predictors reduced the within-cluster variance from 2.12 to 2.11 (less than a 0.4% reduction), and the level-2 predictors and interaction terms reduced the between-cluster variance from 2.12 to 2.11 (a 0.4% reduction). The overall results of level-1 coefficient were similar to baseline model. Both morning pain ( $p < .001$ ) and positive affect ( $p < .05$ ) were statistically significant level-1 predictors. Turning to the level-2 coefficients in Table 8, notice that only pain acceptance was exhibited as a significant negative level-2 predictor ( $p < .001$ ), meaning that after controlling for pain

catastrophizing and the DASS total mean score, relative to participants with lower pain acceptance ratings, participants with higher pain acceptance ratings were less likely to report daily pain interference with work goal pursuit in the afternoon. Finally, a significant cross-level interaction was found between pain acceptance and morning pain intensity. Pain acceptance moderated the within-person relation between morning pain intensity and afternoon pain interference of work goal pursuit ( $p < .05$ ) while controlling for pain catastrophizing and DASS total score. In other words, relative to individuals with lower pain acceptance for individuals with higher pain acceptance, daily morning pain was less strongly associated with an increase in pain interference of work goal pursuit in the afternoon. In order to aid the interpretation of moderation effect and provide a means to investigate how the relation of pain intensity and afternoon pain interference of work goal pursuit changes across levels of pain acceptance, a simple slope analysis, as suggested by Aiken and West (1991), was conducted (see Figure 2).

*Afternoon Pain Interference With Lifestyle Goal Pursuit Model (Equation 4 - 6)*

Turning to pain interference of lifestyle goal pursuit as an outcome model, first, Table 9 provides the parameter estimates, standard errors and  $t$  tests from the analysis of baseline model (Equation 4). Compared to the unconditional model, the level-1 predictors reduced the within-cluster variance from 3.02 to 2.81 (a 6.9% reduction). The results show that there was a significant positive level-1 coefficient for morning pain severity, which means that after controlling for morning positive and negative affect when a participant experienced greater than usual morning pain intensity, he or she reported more pain interference of lifestyle goal pursuit in the afternoon ( $p < .001$ ). It was also found that the morning positive affect had a significant negative coefficient, which indicates

that on morning when participants reported more positive affect than average, they reported less pain interference of lifestyle goal pursuit scores in the afternoon ( $p < .05$ ).

Table 10 provides parameter estimates, standard errors and  $t$  tests from the analysis of the model that includes all level-1 and level-2 predictors. Compared to the baseline model presented above, the level-2 predictors reduced the between-cluster variance from 3.41 to 2.45 (a 28.2% reduction). The overall results of level-1 coefficient were similar to the baseline model. Both morning pain and positive affect were statistically significant level-1 predictors. In case of the level-2 coefficients, only pain acceptance was a negative significant level-2 predictor. Here again, relative to individuals with lower pain acceptance scores, individuals with higher pain acceptance scores were less likely to rate daily pain interference of lifestyle goal pursuit in the afternoon over and above pain catastrophizing and DASS total score.

Table 11 provides parameter estimates, standard errors and  $t$  tests from the analysis of the final model that includes all level-1, level-2 predictors and cross-level interaction terms. In order to test whether the final model with two cross-level interaction terms provide an unique effect over the model with only level-1 and level-2 predictors, -2logLikelihood was compared. Likelihood ratio tests from restricted maximum likelihood estimation revealed that the final model (-2LogLikelihood = 5009.764) did not provide an improvement fit over the model with only level-1 and level-2 predictors (-2LogLikelihood = 5010.982;  $\chi^2(2) = 1.22, p = 0.54$ ). Again, how much within- and between-cluster variance was reduced from the baseline model was calculated. It was found that both level-1 and level-2 predictors did not reduce any within-cluster nor between-cluster variance. The overall results of level-1 coefficient were similar to the

baseline model. Both morning pain and positive affect were statistically significant level-1 predictors. In case of the level-2 coefficients, only pain acceptance was exhibited as a negative significant level-2 predictor. Here again, relative to individuals with lower pain acceptance scores, individuals with higher pain acceptance scores were less likely to rate daily pain interference of lifestyle goal pursuit in the afternoon over and above pain catastrophizing and DASS total score. In this final model, we failed to find any cross-level interactions.

*Evening Work Goal Progress Model (Equation 7 - 8)*

The parameter estimates, standard errors and  $t$  tests from the baseline model of work goal progress as outcome model are presented in Table 12. As can be seen in tables compared to the unconditional model, the level-1 predictors reduced the within-cluster variance from 3.20 to 2.56 (a 20% reduction). Consistent with our expectation, it was shown that there was a significant positive level-1 coefficient of afternoon pain interference of work goal pursuit. This result implies that when a participant experienced greater than usual pain interference with work goal pursuit in the afternoon, he or she reported a decrease in work goal progress in the evening ( $p < .01$ ) over and above morning pain, morning positive and negative affect. No other level-1 predictors were exhibited as statistically significant.

The parameter estimates, standard errors and  $t$  tests from the final model of work goal progress as outcome model are presented in Table 13. Compared to the baseline model presented above, the level-2 predictors reduced the between-cluster variance from 2.65 to 2.63 (less than a 1% reduction). Notice that only afternoon pain interference of

work goal pursuit level-1 predictor was significant. None of the other level-1 nor level-2 predictors were significant in the final model.

#### *Evening Lifestyle Goal Progress Model (Equation 9 - 10)*

Table 14 provides the parameter estimates, standard errors and *t* tests from the analysis of the baseline lifestyle goal progress as outcome model. Compared to the unconditional model, the level-1 predictors reduced the within-cluster variance from 2.98 to 2.75 (a 7.7% reduction). Contrary to our expectation, none of the level-1 predictors were significant.

Finally, table 15 includes parameter estimates, standard errors and *t* tests from the final model of lifestyle goal progress as outcome. Compared to the baseline model presented above, the level-2 predictors reduced the between-cluster variance from 2.89 to 2.81 (a 2.8% reduction). None of the level-2 predictors included in the final model were found to be significant.

#### *Mediation Analysis*

As described above, in order to evaluate the significance of the mediation effect, the procedure suggested by Mackinnon and colleagues (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; MacKinnon, Lockwood, & Williams, 2004) was followed by using PRODCLIN software. It was concluded that a significant indirect effect exists if zero is not included in the 95% confidence interval.

First, it was tested whether morning pain intensity exerts an indirect effect on goal progress in the evening via afternoon pain interference with goal pursuit. There was a significant mediated effect through pain interference with goal pursuit in the work goal model ([95% confidence interval] -0.02945, -0.00318) but not in the lifestyle goal model

([CI] -0.01944, 0.00563). Second, conditional indirect effects were tested to determine whether the mediated effects differ across different levels of a moderating variable (i.e., pain acceptance). In the present study, this particular test was only carried out with pain acceptance as a moderator of the within-person association between morning pain intensity and afternoon pain interference with work goal pursuit because: (1) the results revealed that pain acceptance was the only statistically significant moderating variable between morning pain rating and afternoon pain interference with work goal pursuit; and (2) none of the moderators were found to be significant in the lifestyle goal model. Three different mediated effects were investigated with different estimates of alpha path and standard errors when pain acceptance was (1) one standard deviation above the mean, (2) at its mean, and (3) one standard deviation below the mean. The results showed that when the level of pain acceptance was at its mean or one standard deviation below the mean, the association between morning pain intensity and evening work goal progress was significantly mediated by afternoon pain interference with work goal pursuit ([CI] -0.02945, -0.00318 and [CI] -0.04588, -0.00542, respectively). However, it was found that the relationship between morning pain intensity and evening work goal progress was not significantly mediated by pain interference of work goal pursuit in the afternoon when pain acceptance was at one standard deviation above the mean ([CI] -0.02099, 0.00491).

## **DISCUSSION**

A number of studies have examined the motivational process and its association with chronic pain. However, most of these were either cross-sectional (Karoly & Ruehlman, 1996), from which it is difficult to draw causal inference, or experimental studies (Schrooten, 2012; Van Damme, Van Ryckeghem, Wyffels, Van Hulle, & Crombez,



2012; Verhoeven et al., 2010), with limited ecological validity and external validity due to their reliance on a tightly controlled environment (Kazdin, 2002). Thus, researchers started to shift their attention to utilizing a methodology that might reflect greater reliability and ecological validity. The daily diary methodology was found to meet these important needs by enabling investigation of both between-person (i.e., individual differences) and within-person differences (i.e., state differences). As a result, based on this sophisticated method, daily pain and motivational dynamics (Affleck et al., 1998; Affleck et al., 2001; Hardy, Crofford, & Segerstrom, 2011; Karoly, Okun, Enders, & Tennen, in press), affect (Zautra, Johnson, & Davis, 2005), sleep (O'Brien et al., 2011), and resilience (Ong, Zautra, & Carrington, 2010) have been investigated. However, limited prospective research has been conducted to examine the process of daily pain on the achievement of one's different types of goals. Furthermore, the study of what types of personal characteristics influence this process has not received much attention either.

The main purpose of the present study, therefore, was to probe the underlying mechanisms and to understand how an increase in daily pain interferes with daily work- and lifestyle goal progress by utilizing the daily diary method. To be specific, as progress of a goal fundamentally depends upon how successfully individuals could pursue their goal during the day, daily pain interference with work- and lifestyle goal pursuit was included as a mediator of the relationship between daily pain intensity and work- and lifestyle goal progress later in the day. In addition, individual difference variables such as pain acceptance and pain catastrophizing, which are widely known as powerful indicators of the adjustment of pain among individuals (cf., Keefe et al., 1989; Viane et al, 2003), were included as moderating variables to test whether they influence (i.e., either attenuate

or strengthen) the relationship between pain intensity and its interference of work- and lifestyle goal pursuit. The results of the present study supported many of the main hypotheses. Although some results were somewhat unexpected, we observed both significant indirect effects and a significant cross-level interaction via pain acceptance in the work goal model. The summary of these findings is presented in Figure 3 and Figure 4.

### **Impact of Morning Pain Intensity on Interference with Goal Pursuit**

Studies have found that pain interrupts one's effective goal pursuit (cf., Affleck et al., 1999; Affleck et al., 2001; Van Damme, Legrain, & Crombez, 2010) and the same result was expected to be replicated in the present study for two conceptually heterogeneous goal types, work goal and lifestyle goal. It was found that experiencing more than usual pain intensity in the morning significantly predicted an increase in pain interference with both work- and lifestyle goal pursuit in the afternoon over and above morning positive and negative affect. The consistency of this finding implies that heightened nociceptive experience in the beginning of the day significantly predicted pain's disruption with one's daily work-and lifestyle goal pursuit. Although testing sophisticated internal biophysiological mechanisms to determine how pain causes interference with goal pursuit was not a goal of the current study, previous findings provide some potential explanations for this hypothetical mechanism: (1) exposure to pain for an extended period of time deteriorates one's executive function (Eccleston, 1995; Grisart & Plaghki, 1999) such that individuals become less effective in pursuing their goals; (2) individuals with chronic pain become focused on pursuing pain-related goals rather than other important personal goals (Van Damme, Legrain, & Crombez, 2010); and

(3) pain is often catastrophically misinterpreted inducing pain-related fear avoidance (see Leeuw et al, 2007; Vlaeyen & Linton, 2000 for review) which then results in anxiety and a significant decrease in the pursuit of other meaningful life goals.

All those factors seem to exert an influence on the hindrance of one's successful goal pursuit. However, how an individual perceives goal interference likely depends on individual differences. Thus, the present study attempted to investigate how two common pain-related individual characteristics, pain acceptance and pain catastrophizing, might moderate the relationship between morning pain intensity and afternoon pain interference of work- and lifestyle goal pursuit. The results showed that there was a statistically significant pain acceptance cross-level interaction effect with morning pain intensity in the work goal model. The interaction effect was then examined in more detail by testing how the association between pain intensity and interference of work goal pursuit varies across different levels of pain acceptance. When the pain acceptance level was either at one's mean or one standard deviation below the mean, morning pain intensity significantly accounted for pain's interference with work goal pursuit in the afternoon. On the other hand, when the pain acceptance level was at one standard deviation above the mean, there was no longer a statistically significant relationship between morning pain and afternoon pain interference with work goal pursuit.

This finding is somewhat striking in that it shows how pain acceptance serves as a key variable in disconnecting the pain and work goal pursuit interference chain. A potential explanation for this finding can be offered by reflecting on the operational definition of pain acceptance. Pain acceptance does not mean ignoring or distracting attention away from pain. Rather, it is decreasing unnecessary obsession to either avoid or

control pain, trying to engage in personally meaningful activities, and pursuing valuable goals with the existence of pain (McCracken, Vowles, & Eccleston. 2004). Therefore, it is likely that individuals who have a high pain acceptance level will not be as readily interrupted in their daily work goal pursuit by an increase in pain because they are willing to accept and coexist with pain while pursuing their important goals. Surprisingly, despite the fact that engagement of meaningful goals and activities even with experience of pain is the key to pain acceptance, most studies on pain acceptance primarily focused on how pain acceptance is related to psychological flexibility (McCracken & Gutierrez-Martinez, 2011), physical and psychosocial functioning (McCracken & Eccleston, 2005; Vowles et al., 2007), affective well-being (Kranz, Bollinger, & Nilges, 2010), or mental health (Viane et al, 2003). The present study is one of the few that casts light on how pain acceptance taps into the daily goal pursuit process of people with chronic pain.

The identical model of the lifestyle goal, however, was inconsistent with that of the work goal model. It was found that there was no statistically significant moderator in this model. The inconsistency of this finding indicates that the relationship between morning pain intensity and afternoon pain interference with lifestyle goal pursuit is independent of pain acceptance. Presumably, the fundamental characteristic difference between a work goal and a lifestyle goal might have led to this unexpected outcome. Whereas work goals are often focused on relationships with an individual's colleagues or boss, lifestyle goals are primarily centered on self. In other words, work goals often accompany an obligation to be productive in the workplace (e.g., meeting a deadline for submitting a proposal, calling 15 customers per day, etc.); and often external forces have an influence here (e.g., being scolded by one's boss, being worried about not being promoted, etc.). However,

lifestyle goals (e.g., losing 10 pounds, reading a self-help book for one hour daily) do not strictly require responsibilities in pursuit of them because external pressure does not usually intervene. Hence, if more than usual pain is experienced in the morning, regardless of the different levels of pain acceptance, peoples' lifestyle goal pursuit might likely be significantly impeded. It is possible that although individuals are highly accepting of their pain experience, they could more easily give up pursuing their lifestyle goals because there is not much obligation and pressure. In addition, high pain acceptance does not necessarily make people more goal-oriented, nor does it influence them to put forth more effort in pursuing their goals. Clearly, further investigations and replications are required to support this speculation.

The influence of the other personal characteristic, pain catastrophizing, was also tested in the present study. Previous studies have repeatedly shown that pain catastrophizing is strongly associated with functional disability (Arnow et al., 2011; Somers et al., 2009; Ulrich, Jensen, Loswer, & Cardenas, 2007) and is a precursor of fear avoidance (Leeuw et al., 2007; Vlaeyen & Linton, 2000). Therefore, based on these findings it was expected that having a high pain catastrophizing level would strengthen the association between pain intensity and its interference of work- and lifestyle goal pursuit. The results, however, indicated that pain catastrophizing was not a statistically significant moderator for both the work- and lifestyle goal models. One of the potential causes for this null effect of catastrophizing may simply be a variance overlap with pain acceptance because the two are highly correlated ( $r = -0.61$ ). However, it was found that even when pain acceptance was excluded in the analysis, pain catastrophizing remained a

non-significant moderating variable. Hence, the influence of pain catastrophizing in a daily diary context (as a level-2 variable) needs to be further investigated.

### **Afternoon Pain Interference with Goal Pursuit and Goal Progress**

To my knowledge, there has not yet been any study which has focused on examining the association between goal pursuit interference and goal progress. It appears that most researchers have been taking it for granted that goal pursuit is necessary for goal progress. If one did not pursue his or her goal, it would not logically make sense that one could have made progress. Based upon this logic, it was expected that if one's goal pursuit is significantly impeded by pain, then his or her progress towards achieving a goal would be significantly interrupted as well. However, when this hypothesis was tested in the daily context, surprisingly, only the work goal model supported this hypothesis. There was no statistically significant relationship between afternoon pain interference of lifestyle goal pursuit and its progress in the evening. Here I suggest a plausible scenario for the interpretation of this somewhat odd result. First, we should be aware that the daily diary methodology is fundamentally dependent on self-report, and thus the truth might have been distorted by the individuals themselves. Second, human beings are goal-oriented, and thus every individual has some specific goals to pursue and expects to make some progress toward achieving these. Due to this expectation, it is possible that people became lenient on themselves in terms of how much goal progress they made. However, there are some goals for which this behavior is fundamentally limited. For instance, in the case of a work goal, it may be difficult to distort the result of one's goal progress. The outcomes are often obvious (e.g., my work goal today was to call 15 clients, but I only called 10 clients) and, furthermore, the progress of attaining goals is often associated with

others, such as one's colleagues or one's boss. However, in the case of a lifestyle goal, there are more room for one to be careless in tracking goal progress because there is basically no one to check on them or blame them for not making sufficient goal progress.

In this manner, in the case of a lifestyle goal, it might be easy for people to utilize cognitive dissonance (Festinger, 1985) to justify their impedance of goal progress.

According to Festinger (1985), cognitive dissonance occurs when two or more conflicting cognitions or values are simultaneously happening to individuals and consequently causing them to feel frustrated. Since people presumably have the motivational drive to reduce this inner conflict, they choose one of the dissonant values and create an altered but consistent belief system. Applying this theory to lifestyle goal progress, an individual may experience discomfort by having two conflicting cognitions as follows: (1) there was a significant interference today in pursuing my lifestyle goal (e.g., exercise to lose 10 pounds) due to pain; and (2) I was not able to make measurable progress on my lifestyle goal today; however, (3) having some progress is very important. There are two conflicting cognitions in this case: (a) I want to make some progress on my lifestyle goal everyday; (b) I was not able to make enough progress today due to pain. So as to decrease the discomfort generated by those two conflicting thoughts, the person will then choose one of the dissonant values (e.g., the goal of losing 10 pounds through exercise is more important) and will attempt to rationalize it by creating an altered belief system (e.g., although I was not able to exercise today due to pain, I did not have an appetite and I ate smaller portions. Therefore, I made progress on achieving my goal of losing 10 pounds). Another possibility that explains the null effect of pain interference with lifestyle goal pursuit on goal progress might be related to a considerable decrease in the number of

observation for the afternoon and evening outcome variables due to the design of this study. This might have resulted in a significant decrease in statistical power to detect an effect. However, it seems quite clear that the effect of pain interference with goal pursuit on goal progress is much smaller in the lifestyle goal model than in the work goal model.

### **Moderated Mediation from Morning Pain Intensity to Evening Goal Progress**

Some previous studies investigated the relationship between pain and goal progress among female fibromyalgia patients (Affleck et al 1998; 2001). However, a theoretically more complicated model seems to be required to shed light on the within-day process of goal progress when there is a change in pain intensity. In the present study, therefore, the relationship between morning pain intensity and evening work- and lifestyle goal progress was expected to be mediated through afternoon pain interference with work- and lifestyle goal pursuit. Furthermore, we assumed that these mediated effects would potentially be moderated by some individual differences, such as pain catastrophizing and pain acceptance.

The results of the present study showed that there was no direct effect between morning pain intensity and evening goal progress in both the work- and lifestyle goal models while controlling for the mediator interference with goal pursuit. This is consistent with our assumption that there might be a weak association between daily pain change and goal progress based on previous findings (Affleck et al., 1998). The results of the mediation analysis showed that there was a significant mediation effect in the work goal model but not in the lifestyle goal model. Specifically, in the case of the work goal model, afternoon pain interference of work goal pursuit was found to significantly mediate the relationship between pain and work goal progress ignoring the



level-2 moderator variables. In addition, since the pain acceptance variable significantly moderated the relationship between the dependent and mediating variable (i.e., the alpha path in the simple mediation model), a test for moderated mediation effect was also conducted. Consequently, a total of three mediated effects were tested by computing three different alpha path estimates: (1) when the level of pain acceptance is one standard deviation below the mean, (2) at its mean, and (3) one standard deviation above the mean. The results indicated that when pain acceptance is either at the mean or one standard deviation below the mean, there were significant mediated effects. However, when the value of pain acceptance is one standard deviation above the mean, interestingly, there was no longer a significant mediated effect due to the non-significant action theory (i.e., alpha path). To put it simpler way, for people who are one standard deviation above the mean on pain acceptance, the within-person association between pain and its interference with work goal pursuit is attenuated. Thus, they can effectively decrease the impedance of work goal progress later in the day. For people who are high in pain able to uncouple pain intensity and daily work goal obstacles related to pain. On the other hand, if people have low pain acceptance, they will struggle with pursuing and achieving their work goals when there is a spike in their pain. The repeated daily self-regulatory failures, such as interruption of goal pursuit and progress, have potential to result in deleterious outcomes in work settings (e.g., increase in absence rate, depression, anxiety, and decrease in work efficiency, positive affect, self-efficacy). This finding might provide us with some clues to solve the mystery of why some individuals with chronic pain are highly dysfunctional in the work place and others are not.

Interestingly, the results were quite different in the lifestyle goal model. First, pain interference of lifestyle goal was not found to be a significant mediator due to the failure of the conceptual theory (i.e., beta path). Furthermore, none of the moderating variables had a significant interaction effect on the action theory (i.e., alpha path) of the model. Various factors could have influenced this result. It seems that the results of the mediated effect could be different depending on different types of goals. As mentioned above, the characteristic difference between work- and lifestyle goal might have played a significant role. In order for people with chronic pain to receive maximum benefits from high pain acceptance, presumably their goals should be highly meaningful and be placed as high priority goals.

### **Limitations**

The present study has a number of limitations that need to be addressed in future research. First of all, the readers should be careful in generalizing the results because the sample of the present study consisted of non-clinically-referred individuals with chronic pain. In reality, however, a considerable number of people struggling with chronic pain are not clinically referred, and thus it is valuable to study this population as well. Second, the results are solely based on the self-report measure of daily diary, which can increase common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Although it has been demonstrated that diary data effectively decreases problems with recall bias (Tennen & Affleck, 1996), depending solely on data obtained this way might make it difficult for researchers to draw objective conclusions from the data. Thus, for instance, it would be more accurate to measure one's progress of a work-related goal by using both self-reported ratings and peer or supervisor-reported ratings. Another limitation is a

significant decrease in person days (i.e., observations) for afternoon and evening goal measures. This could have significantly dropped the statistical power to detect a small effect such as beta path (afternoon pain interference of lifestyle goal pursuit → evening lifestyle goal progress) in the lifestyle goal model. Last, the concept of a lifestyle goal seemed to capture many different kinds of goals that can potentially be categorized separately (e.g., health-related goals and social goals). This could have contributed to some unexpected findings in the present study.

### **Implications for Future Studies**

In spite of these limitations, the current study provides some important stepping stones for future research in understanding the process of pain self-regulation for people with chronic pain. First, in order to generalize the present findings, the study needs to be replicated using a clinical sample such as individuals diagnosed with fibromyalgia, rheumatoid arthritis, or lower-back pain. Second, more objective evidence is required to prove assumptions made about how exactly and broadly pain interrupts one's goal pursuit. More advanced neuro-physiological technology, such Event Related Potentials (ERP) and fMRI, would further help us to identify and unpack the relevant mechanisms. Third, although most goal-based research, including the present study, only focuses on one or two goals, it is important to consider some other goals that might be particularly relevant for individuals with chronic pain. For example, pain-related goals (e.g., controlling pain and avoiding situations that cause pain) are among the most highly prioritized goals among those individuals. However, pursuit of these goals can often impede pursuit of some other important personal goals (Van Damme, Legrain, Vogt, & Crombez, 2010). Understanding the conflicts and dynamics between pain-related goals and other important

personal goals in terms of a within-day context will prove to be invaluable in treatment planning for chronic pain disorders or in designing new psychological interventions. Last, further investigation in examining the power of pain acceptance over successful daily goal process is required. Although the level of pain acceptance differs by individuals, numerous studies have demonstrated that one can significantly increase pain acceptance through acceptance-commitment therapy (ACT) (Buhrman et al., 2013; McCracken & Jones, 2012; Wetherell et al., 2011). Furthermore, ACT has been found to enhance many different emotional, psychosocial, and physical functioning indicators for people with chronic pain (Buhrman et al., 2013; McCracken & Gutierrez-Martinez, 2011; McCracken & Jones, 2012; Wetherell et al., 2011; Wicksell, Ahlqvist, Bring, Melin, & Olsson, 2008), all of which are fundamentally associated with achieving one's goals.

However, our understanding how the underlying mechanism of pain acceptance assists individuals to successfully control themselves in pursuing and achieving their meaningful goals is still incomplete. A nuanced understanding of this specific mechanism would clearly be beneficial for providing effective coping strategies for individuals with chronic pain and for preventing the development or exacerbation of psychosocial problems that are caused by pain. Testing the present model in a randomized control ACT intervention study could be a useful and realistic future venue. Nonetheless, more sophisticated pre-post test designs might be required. For example, Zautra and his colleagues (2008) compared the effects of cognitive-behavioral therapy and mindfulness meditation on such outcomes as pain reduction and control, positive negative affect, and emotion regulation among rheumatoid arthritis patients. Before the intervention started, participants completed 30-day diaries and after the intervention (post-intervention), they

again completed daily diaries. Recently, Davis and Zautra's study (2013) of an online mindfulness intervention also provides a useful intervention design. Participants first completed daily diaries prior to the intervention for few days and once they were randomized into intervention and control groups, daily diaries were assessed throughout the intervention. These new intervention designs make it possible for researchers to more accurately investigate the effects and processes underlying an intervention. In short, testing the present model via designs such as these would clearly contribute to shedding light on the effects of pain acceptance on daily goal pursuit and progress among chronic pain patients.

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Table 1

*Descriptive statistics and Between-Person Variance, Within-person Variance and ICC for Level-1 Variables*

Variable	M	SD	Between-Person Variance	Within-Person Variance	ICC
<i>Level-1 Variables</i>					
Morning Pain Intensity	3.54	2.20	2.69	2.25	0.54
Morning Positive Affect	5.05	1.94	2.44	1.37	0.64
Morning Negative Affect	1.15	1.66	1.34	1.70	0.44
Afternoon Pain Interference of Work Goal	2.09	2.44	3.04	2.58	0.54
Afternoon Pain Interference of Lifestyle Goal	2.21	2.58	3.51	3.02	0.54
Evening Work Goal Progress	6.14	2.44	2.87	3.20	0.47
Evening Lifestyle Goal Progress	6.26	2.39	2.67	3.07	0.47
<i>Level-2 Variables</i>					
Pain Acceptance	3.69	0.81			
Pain Catastrophizing	1.76	0.67			
DASS total score	0.68	0.49			

□

Table 2

*Correlation Table of Day-Level Variables (Person Mean Centered)*

Variable	1	2	3	4	5	6	7
1. Morning Pain Intensity	—	-0.18**	0.11**	0.19**	0.20**	-0.01	-0.02
2. Morning Positive Affect		—	-0.31**	-0.13**	-0.09**	0.01	0.04
3. Morning Negative Affect			—	0.03*	0.02*	0.00	-0.03
4. Afternoon Pain Interference of Work Goal Pursuit				—	0.43**	-0.07*	-0.10**
5. Afternoon Pain Interference of Lifestyle Goal Pursuit					—	-0.11	0.03
6. Evening Work Goal Progress						—	0.20*
7. Evening Lifestyle Goal Progress							—

\*  $p < .05$  \*\*  $p < .01$

Table 3

*Correlation Table of Person-Level Variables and Level-1 Outcome Variables*

Variable	1	2	3	4	5	6	7
1. Pain Acceptance	—	-0.61**	-0.38**	-0.49**	-0.46**	-0.01	-0.02
2. Pain Catastrophizing		—	0.54**	0.42**	0.34**	-0.04	0.01
3. DASS Total Score			—	0.33**	0.25**	-0.01	-0.06
4. Afternoon Pain Interference of Work Goal Pursuit				—	0.73**	0.02	0.01
5. Afternoon Pain Interference of Lifestyle Goal Pursuit					—	0.01	0.06
6. Evening Work Goal Progress						—	0.56**
7. Evening Lifestyle Goal Progress							—

\*  $p < .05$  \*\*  $p < .01$

Table 4

*The Proportion Reduction in Error at Level-1 and Level-2 (Pseudo-R<sup>2</sup> Values) for both afternoon pain interference of work- and lifestyle goal pursuit*

Outcome	Model	Within cluster variance	Within Cluster Variance Reduction	Between Cluster Variance	Between Cluster Variance Reduction
Afternoon Pain Interference of Work Goal Pursuit	Unconditional	2.58	N/A	3.04	N/A
	Level-1 predictors only	2.11	18.2%	3.09	N/A
	Level-1 and Level-2 predictors	2.12	N/A	2.12	31.4%
	Full model (including Interaction Terms)	2.11	0.4%	2.11	0.4%
Afternoon Pain Interference of Lifestyle Goal Pursuit	Unconditional	3.02	N/A	3.51	N/A
	Level-1 predictors only	2.81	6.9%	3.41	N/A
	Level-1 and Level-2 predictors	2.81	N/A	2.45	28.2%
	Full model (including Interaction Terms)	2.81	0%	2.45	0%

*Note.* N/A means not applicable to calculate variance reduction. For example, when grand mean centered level-2 variables are included on top of level-1 predictors only model, there should be no within cluster variance reduction because grand mean centered level-2 predictors are orthogonal to person mean centered level-1 variables. Some changes of the value of variance are due to estimation error.

Table 5

*The Proportion Reduction in Error at Level-1 and Level-2 (Pseudo-R<sup>2</sup> Values) for both evening work- and lifestyle goal progress*

Outcome	Model	Within cluster variance	Within Cluster Variance Reduction	Between Cluster Variance	Between Cluster Variance Reduction
Evening Work Goal Progress	Unconditional model	3.20	N/A	2.87	N/A
	Level-1 predictors only	2.56	20%	2.65	N/A
	Level-1 and Level-2 predictors	2.56	N/A	2.63	0.7%
Evening Lifestyle Goal Progress	Unconditional Model	2.98	N/A	2.87	N/A
	Level-1 predictors only	2.75	7.7%	2.89	N/A
	Level-1 and Level-2 predictors	2.75	N/A	2.81	2.8%

*Note.* N/A means not applicable to calculate variance reduction. For example, when grand mean centered level-2 variables are included on top of level-1 predictors only model, there should be no within cluster variance reduction because grand mean centered level-2 predictors are orthogonal to person mean centered level-1 variables. Some changes of the value of variance are due to estimation error.

Table 6

*MLM Parameter Estimates from the Pain Interference of Work Goal Pursuit Analysis( Level-1 Predictors only)*

Parameter	Est.	SE	<i>t</i>	<i>p</i>
Intercept	1.936	0.163	11.849	< .001
Pain Intensity (Level-1)	0.157	0.041	3.826	< .001
Positive Affect (Level-1)	-0.142	0.044	-3.217	< .01
Negative Affect (Level-1)	-0.033	0.051	-0.657	0.511
Intercept Variance	3.088	0.420		
Pain Intensity Slope Variance	0.051	0.026		
Negative Affect Slope Variance	0.053	0.033		
Residual Variance	2.154	0.283		
Intercept-Slope (Pain) Covariance	0.144	0.064		
Intercept-Slope (Negative affect) Covariance	-0.037	0.105		

*Note.* Wald tests are invalid for variance estimates and are omitted from the table.

Table 7

*MLM Parameter Estimates from the Pain Interference of Work Goal Pursuit Analysis (Level-1 and Level-2 Predictors)*

Parameter	Est.	SE	<i>t</i>	<i>p</i>
Intercept	1.937	0.138	14.014	< .001
Pain Intensity (Level-1)	0.161	0.040	4.229	< .001
Positive Affect (Level-1)	-0.147	0.044	-3.328	< .05
Negative Affect (Level-1)	-0.035	0.051	-0.682	.495
Pain Acceptance (Level-2)	-0.780	0.219	-3.556	< .001
Pain Catastrophizing (Level-2)	0.449	0.287	1.562	.118
DASS total (Level-2)	0.384	0.337	1.139	.255
Intercept Variance	2.121	0.304		
Pain Intensity Slope Variance	0.048	0.021		
Negative Affect Slope Variance	0.052	0.026		
Residual Variance	2.117	0.097		
Intercept-Slope (Pain) Covariance	0.078	0.061		
Intercept-Slope (Naaffect) Covariance	-0.029	0.069		

*Note.* Wald tests are invalid for variance estimates and are omitted from the table.

Table 8

*MLM Parameter Estimates from the Pain Interference of Work Goal Pursuit Analysis (Full Model)*

Parameter	Est.	SE	<i>t</i>	<i>p</i>
Intercept	1.932	0.138	14.033	< .001
Pain Intensity (Level-1)	0.156	0.040	3.885	< .001
Positive Affect (Level-1)	-0.149	0.044	-3.377	< .01
Negative Affect (Level-1)	-0.039	0.050	-0.776	.438
Pain Acceptance (Level-2)	-0.838	0.216	-3.877	< .001
Pain Catastrophizing (Level-2)	0.417	0.288	1.451	.147
DASS total (Level-2)	0.387	0.336	1.150	.250
Pain Intensity x Pain Acceptance	-0.149	0.064	-2.322	< .05
Pain Intensity x Pain Catastrophizing	-0.073	0.071	-1.029	0.303
Intercept Variance	2.107	0.138		
Pain Intensity Slope Variance	0.045	0.019		
Negative Affect Slope Variance	0.050	0.026		
Residual Variance	2.107	0.302		
Intercept-Slope (Pain) Covariance	0.074	0.059		
Intercept-Slope (Naaffect) Covariance	-0.025	0.069		

*Note.* Wald tests are invalid for variance estimates and are omitted from the table.



Table 9

*MLM Parameter Estimates from the Pain Interference of Lifestyle Goal Pursuit Analysis (Level-1 Predictors Only)*

Parameter	Est.	SE	<i>t</i>	<i>p</i>
Intercept	2.127	0.178	11.948	< .001
Pain Intensity (Level-1)	0.211	0.039	5.469	< .001
Positive Affect (Level-1)	-0.109	0.044	-2.476	< .05
Negative Affect (Level-1)	-0.041	0.051	-0.797	.426
Intercept Variance	3.408	0.507		
Pain Intensity Slope Variance	0.036	0.032		
Residual Variance	2.813	0.366		
Intercept-Slope (Pain) Covariance	0.192	0.078		

*Note.* Wald tests are invalid for variance estimates and are omitted from the table.

Table 10

*MLM Parameter Estimates from the Pain Interference of Lifestyle Goal Pursuit Analysis (Level-1 and Level-2 Predictors)*

Parameter	Est.	SE	<i>t</i>	<i>p</i>
Intercept	2.135	0.154	13.891	< .001
Pain Intensity (Level-1)	0.219	0.041	5.290	< .001
Positive Affect (Level-1)	-0.110	0.048	-2.280	< .05
Negative Affect (Level-1)	-0.036	0.048	-0.765	.444
Pain Acceptance (Level-2)	-0.887	0.218	-3.884	< .001
Pain Catastrophizing (Level-2)	0.217	0.309	0.704	.482
DASS total (Level-2)	0.332	0.365	0.909	.363
Intercept Variance	2.452	0.372		
Pain Intensity Slope Variance	0.039	0.024		
Residual Variance	2.815	0.125		
Intercept-Slope (Pain) Covariance	0.163	0.071		

*Note.* Wald tests are invalid for variance estimates and are omitted from the table.

Table 11

*MLM Parameter Estimates from the Pain Interference of Lifestyle Goal Pursuit Analysis (Full Model)*

Parameter	Est.	SE	<i>t</i>	<i>p</i>
Intercept	2.132	0.155	13.798	< .001
Pain Intensity (Level-1)	0.218	0.041	5.287	< .001
Positive Affect (Level-1)	-0.110	0.044	-2.507	< .05
Negative Affect (Level-1)	-0.039	0.051	-0.772	.440
Pain Acceptance (Level-2)	-0.937	0.213	-4.398	< .001
Pain Catastrophizing (Level-2)	-0.183	0.324	-0.566	.571
DASS total (Level-2)	0.344	0.405	0.849	.396
Pain Intensity x Pain Acceptance	-0.069	0.045	-1.516	.129
Pain Intensity x Pain Catastrophizing	-0.036	0.053	-0.677	.498
Intercept Variance	2.454	0.403		
Pain Intensity Slope Variance	0.038	0.032		
Residual Variance	2.814	0.125		
Intercept-Slope (Pain) Covariance	0.165	0.079		

*Note.* Wald tests are invalid for variance estimates and are omitted from the table.

Table 12

*MLM Parameter Estimates from the Work Goal Progress Analysis (Level-1 Predictors Only)*

Parameter	Est.	SE	<i>t</i>	<i>p</i>
Intercept	6.092	0.168	36.219	< .001
Pain Interference of Work Goal Pursuit (Level-1)	-0.094	0.035	-2.659	< .01
Pain Intensity (Level-1)	-0.007	0.066	-0.102	.918
Positive Affect (Level-1)	0.033	0.082	0.403	.687
Negative Affect (Level-1)	0.040	0.077	0.519	.604
Intercept Variance	2.653	0.353		
Pain Intensity Slope Variance	0.050	0.050		
Positive Affect Slope Variance	0.151	0.097		
Residual Variance	2.555	0.260		
Intercept-Slope (Pain) Covariance	-0.028	0.106		
Intercept-Slope (Pffect) Covariance	-0.248	0.115		

*Note.* Wald tests are invalid for variance estimates and are omitted from the table.

Table 13

*MLM Parameter Estimates from the Work Goal Progress Analysis (Full Model)*

Parameter	Est.	SE	<i>t</i>	<i>p</i>
Intercept	6.087	0.168	36.297	< .001
Pain Interference of Work Goal Pursuit (Level-1)	-0.093	0.035	-2.632	< .01
Pain Intensity (Level-1)	-0.006	0.067	-0.094	.925
Positive Affect (Level-1)	0.036	0.084	0.432	.666
Negative Affect (Level-1)	0.043	0.077	0.557	.578
Pain Acceptance (Level-2)	-0.211	0.266	-0.795	.426
Pain Catastrophizing (Level-2)	-0.202	0.334	-0.605	.545
DASS total (Level-2)	-0.037	0.403	-0.091	.928
Intercept Variance	2.626	0.347		
Pain Intensity Slope Variance	0.049	0.050		
Positive Affect Slope Variance	0.154	0.099		
Residual Variance	2.556	0.261		
Intercept-Slope (Pain) Covariance	-0.037	0.111		
Intercept-Slope (Pffect) Covariance	-0.249	0.118		

*Note.* Wald tests are invalid for variance estimates and are omitted from the table.

Table 14

*MLM Parameter Estimates from the Lifestyle Goal Progress Analysis (Level-1 Predictors Only)*

Parameter	Est.	SE	<i>t</i>	<i>p</i>
Intercept	6.039	0.182	33.205	< .001
Pain Interference of Lifestyle Goal Pursuit (Level-1)	-0.029	0.028	-1.063	.288
Pain Intensity (Level-1)	-0.025	0.041	-0.625	.532
Positive Affect (Level-1)	0.099	0.083	1.185	.236
Negative Affect (Level-1)	-0.070	0.062	-1.124	.261
Intercept Variance	2.891	0.511		
Positive Affect Slope Variance	0.176	0.114		
Residual Variance	2.749	0.314		
Intercept-Slope Covariance	-0.123	0.113		

*Note.* Wald tests are invalid for variance estimates and are omitted from the table.

Table 15

*MLM Parameter Estimates from the Lifestyle Goal Progress Analysis (Full Model)*

Parameter	Est.	SE	<i>t</i>	<i>p</i>
Intercept	6.035	0.179	33.787	< .001
Pain Interference of Lifestyle Goal Pursuit (Level-1)	-0.029	0.028	-1.060	.289
Pain Severity (Level-1)	-0.026	0.041	-0.638	.524
Positive Affect (Level-1)	0.101	0.083	1.223	.221
Negative Affect (Level-1)	-0.070	0.063	-1.122	.262
Pain Acceptance (Level-2)	-0.218	0.250	-0.874	.382
Pain Catastrophizing (Level-2)	0.260	0.370	0.702	.483
DASS total (Level-2)	-0.476	0.438	-1.086	.277
Intercept Variance	2.813	0.515		
Positive Affect Slope Variance	0.176	0.115		
Residual Variance	2.748	0.314		
Intercept-Slope Covariance	-0.111	0.123		

*Note.* Wald tests are invalid for variance estimates and are omitted from the table.

Figure 1. Sequential mechanism model of work- and lifestyle goal progress in the experience of pain

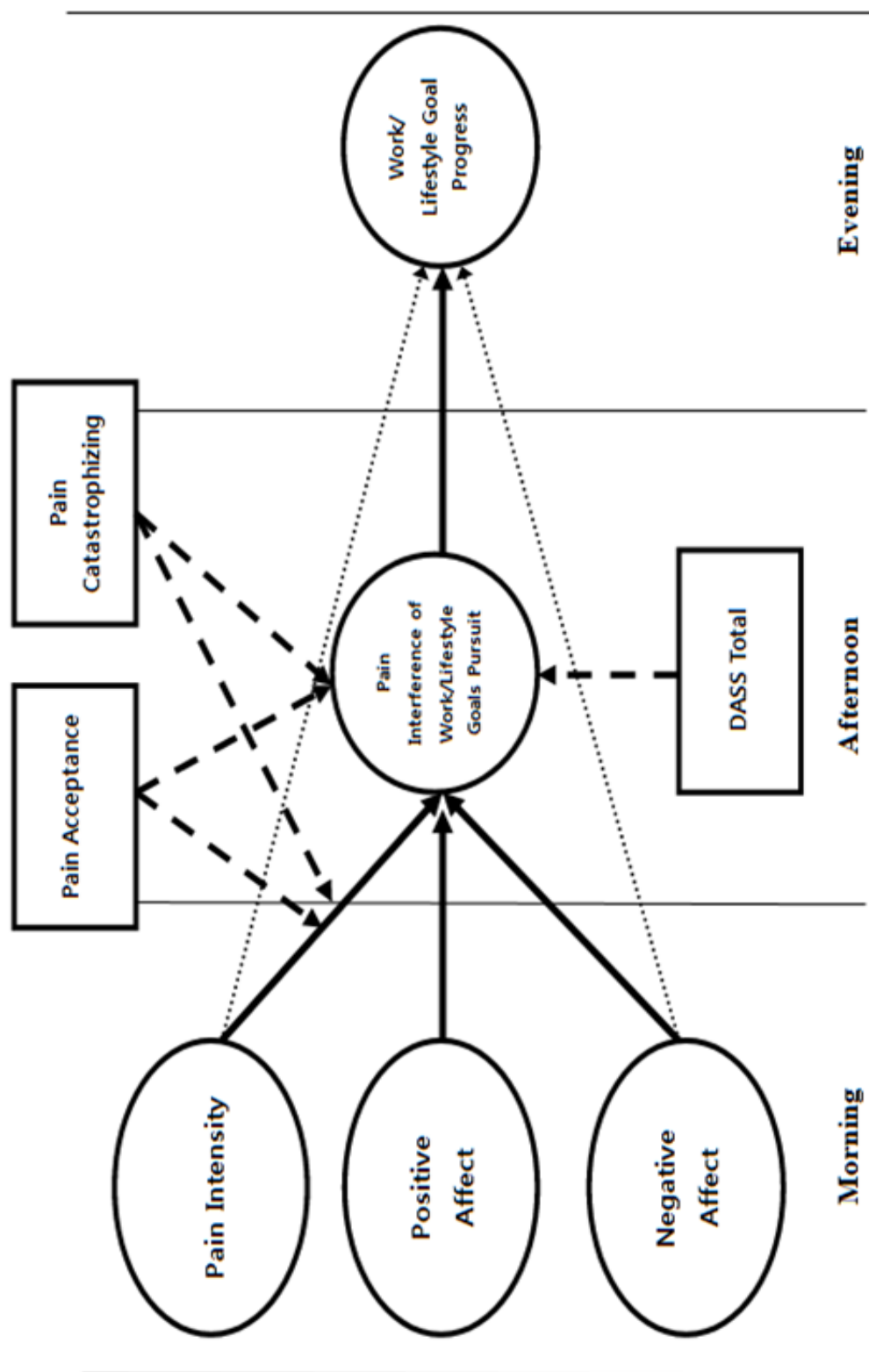
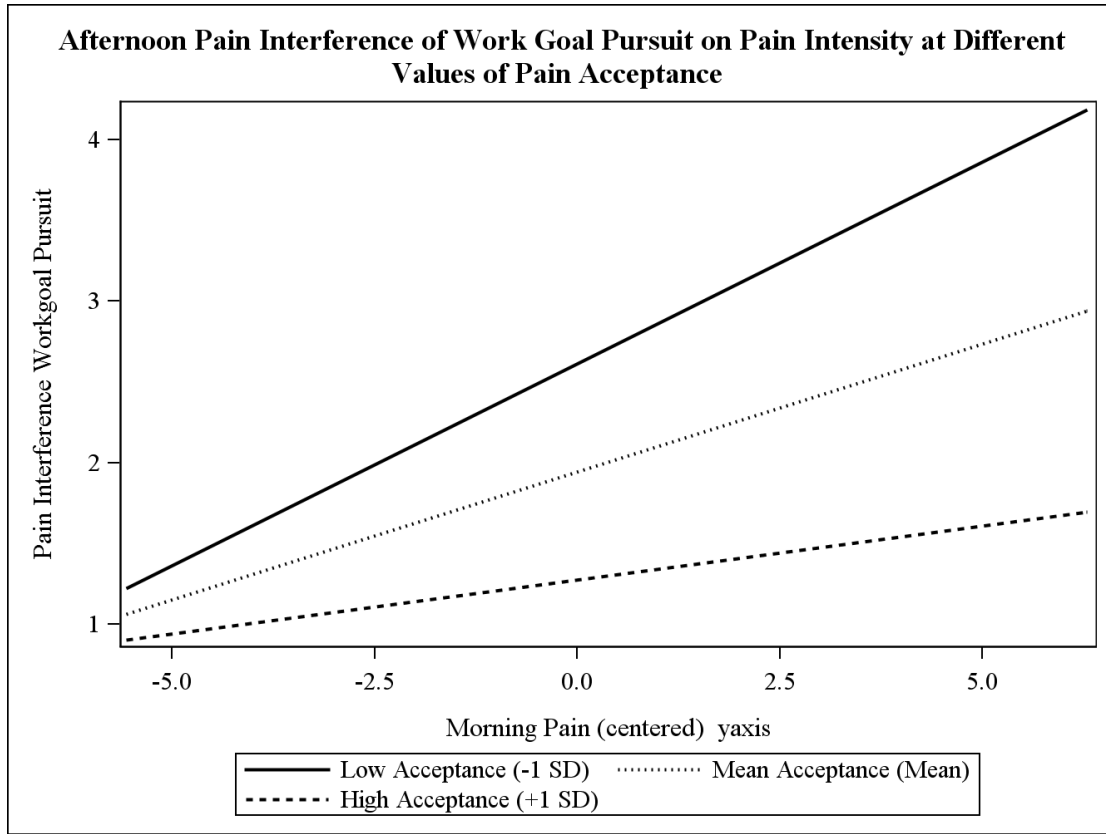


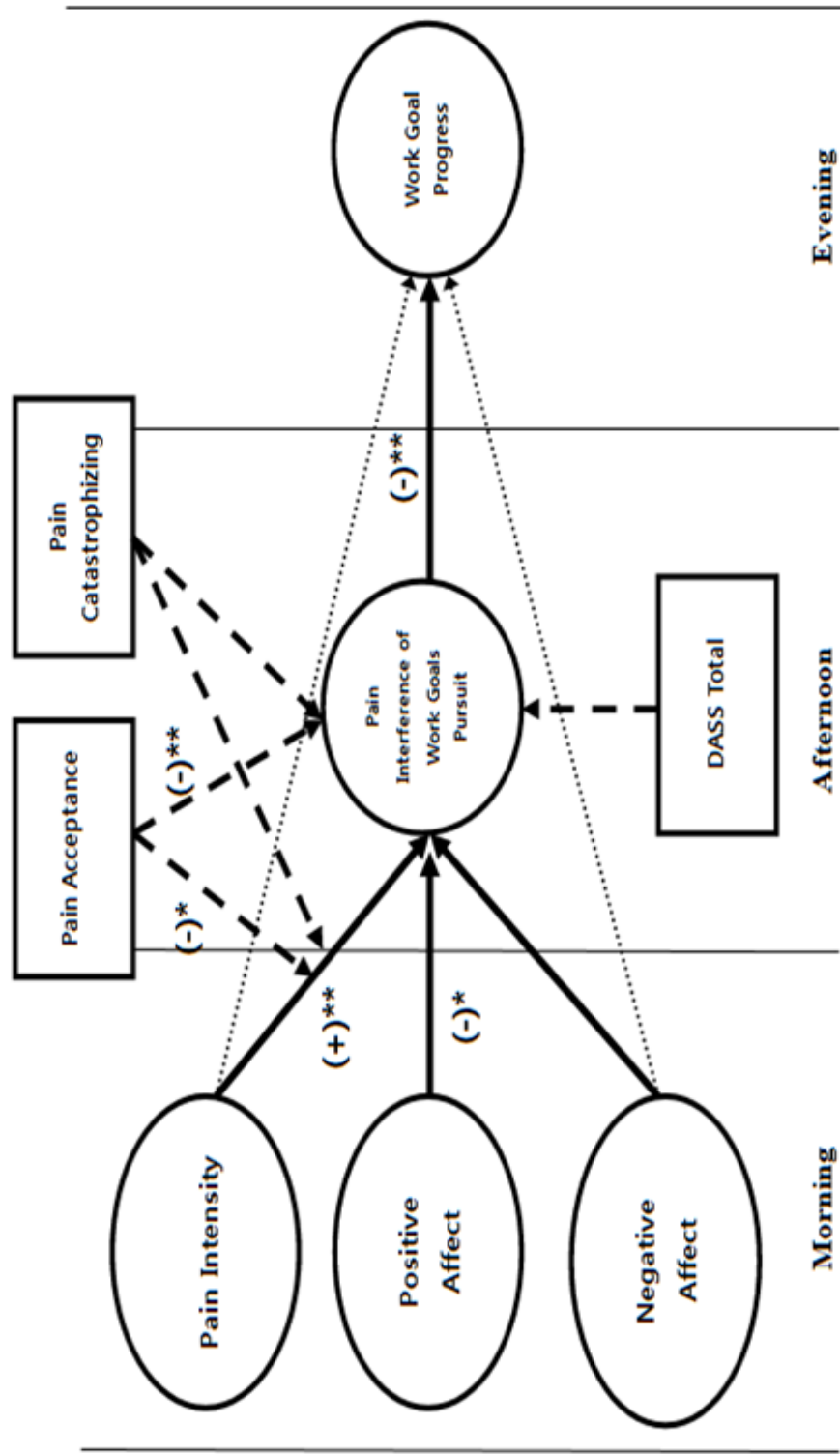


Figure 2. Slopes and intercepts portraying the effects of pain acceptance (-1 SD, mean, +1 SD) on the within-person relations between person-centered pain intensity and afternoon pain's interference with work goal pursuit.



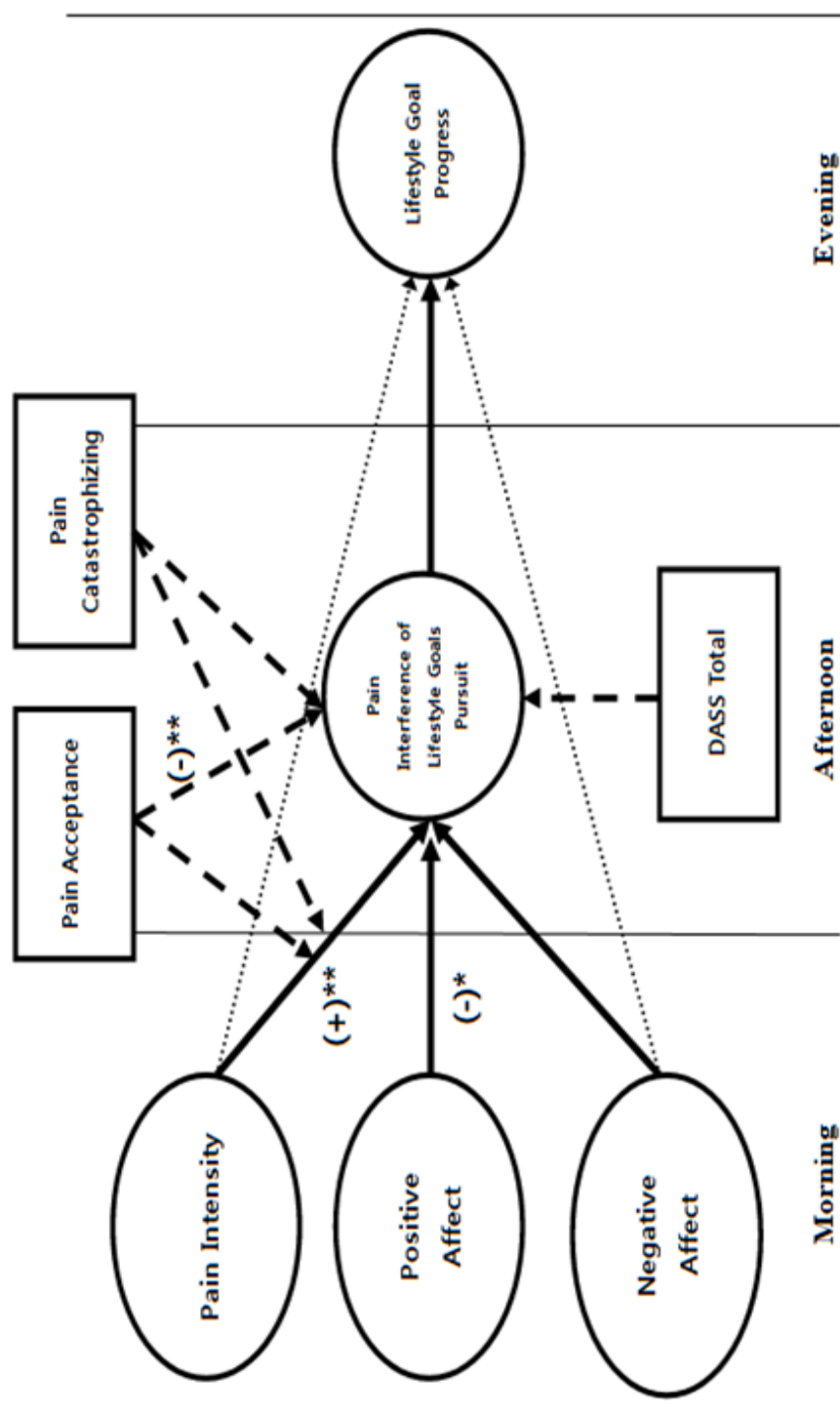
*Note.* When the ratings of pain acceptance is at one standard deviation above its mean,  $\beta = 0.067$ , S.E. = 0.061,  $p = 0.28$ . When the ratings of pain acceptance is at its mean,  $\beta = 0.156$ , S.E. = 0.037,  $p < 0.01$ . When the ratings of pain acceptance is at one standard deviation below the mean,  $\beta = 0.250$ , S.E. = 0.056,  $p < 0.01$ .

Figure 3. Summary of work goal model



Note. (+) = positive correlation, (-) = negative correlation; \*  $p < .05$ ; \*\*  $p < .01$ ; positive and negative affect = level-1 control variables; DASS total = level-2 control variable.

Figure 4. Summary of lifestyle goal model



Note. (+) = positive correlation, (-) = negative correlation; \*  $p < .05$ ; \*\*  $p < .01$ ; positive and negative affect = level-1 control variables; DASS total = level-2 control variable.