THE ROLE OF ANGER IN SCREENING FOR PROGNOSTIC RISK FACTORS AND SUBGROUPING LOW BACK PAIN PATIENTS

By

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To my family, for their encouragement, support, and love

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Low back pain (LBP) is a highly common and costly pain condition that often becomes chronic if not properly addressed. Psychosocial symptoms have been shown to complicate LBP, subsequently necessitating more interdisciplinary treatment methods. The present study specifically investigated the role of anger experience and expression in predicting pain intensity and disability in LBP. This study also examined whether anger contributed to other psychosocial prognostic indicators in identifying treatment outcome risk groups using an empirical statistical approach.

One-hundred and three LBP patients receiving physical therapy completed a series of psychosocial questionnaires at their baseline visit and after one month of treatment. They were also asked to complete the Subgroups for Targeted Treatment (STarT) Screening Tool to assess for Low, Medium, or High risk group classification. Outcome variables were pain intensity, performance-based disability, and patient-reported disability.

Analyses revealed that the three STarT risk groups differed on anger in addition to other psychosocial measures, indicating corresponding levels of negative affect. General psychosocial distress also predicted disability post-treatment, but did not have a strong effect on pain. Empirical subgrouping procedures revealed two patient groups divided on overall psychosocial

distress. Subsequent analyses revealed that the group with less psychosocial symptomatology reported less pain and disability at follow-up. There was also a strong treatment effect, indicating both groups benefitted from therapy.

The findings from this study suggest that anger is part of generalized negative affect in LBP rather than a unique predictor of treatment outcome. Methodological strengths and limitations are explored to guide future research on the role of anger and negative affect in LBP screening procedures and, ultimately, treatment outcome.

CHAPTER 1
INTRODUCTION

Pain is a multidimensional experience, impacting individuals physically, mentally, and emotionally. Although historically conceived of as a purely sensory experience, research in the past 40 years has shown that psychosocial stress and disability accompany pain, thereby leading to interpersonal and intrapersonal problems far beyond the scope of the actual pain condition. Melzack & Casey (1968) were the first to describe the motivational-affective dimension of pain, which entails how one reacts emotionally to acute or chronic sensations of pain. Since this time, the definition of pain has changed to accommodate the "sensory and emotional experience associated with actual or potential tissue damage" (International Association for the Study of Pain, 1994). Therefore, a major focus of the psychological contribution to the pain literature has been the assessment and treatment of emotional aspects of pain and their role in patient quality of life.

Given that pain is a nearly ubiquitous condition, with approximately 25 million people suffering from acute pain and 50 million with chronic pain in the United States, the cost of pain is high. Direct costs of pain, such as diagnostic assessments and physical and pharmacological treatments, and indirect costs of pain, including lost time from work and disability, are estimated to be $125 billion per year (Turk & Melzack, 2001). Specifically, the primary cause of job-related disability is back pain, costing Americans upwards of $50 billion annually (Strine & Hootman, 2007). Often present with no known underlying pathology, back pain is difficult to treat and leads to chronic pain problems in 60-80% of cases consulting primary care (Hill, et al., 2008). Thus, primary prevention efforts aimed at identifying prognostic indicators prior to the development of chronic pain syndromes are crucial in helping control these costs. Current research on contributing factors to chronic pain development and maintenance points towards the

presence of comorbid negative affect, namely depression, anxiety, and, more recently, fear-avoidance beliefs. These commonly addressed psychosocial prognostic indicators will be discussed briefly to elucidate current methods used in primary care and physical therapy settings to help guide treatment in low back pain patients.

Commonly Addressed Negative Emotions in Pain

Depression is the most frequently noted comorbid emotional component of pain, with as many as 30-60% of chronic pain patients in clinic-based samples reporting depressive symptoms (Banks & Kerns, 1996). Depression in pain has been associated with reports of greater pain intensity (Williams, Jacka, Pasco, Berk, & Dodd, 2006), overall negative mood (Feldman, Downey, & Schaffer-Neitz, 1999), pain-related disability (Tan, Jensen, Thornby, & Sloan, 2008), and poorer treatment outcome (Bair, Robinson, Katon, & Kroenke, 2003). Depression has also been shown to be uniquely associated with pain intensity in low back pain (LBP) patients after controlling for other negative emotions, lending some support that negative emotions may have differential effects in the pain experience (George, Wittmer, Fillingim, & Robinson, 2006). In terms of the temporal relationship between depression and pain, there is evidence to suggest a bidirectional effect, such that individuals with premorbid depression may be more sensitive to painful stimuli, and those with a chronic pain condition often experience significant life interference and disability leading to depressed mood (Tan, et al., 2008).

Anxiety is another common negative emotion in pain, and has been related to decreased pain threshold and tolerance in experimental settings (Janssen, Spinhoven, & Arntz, 2004) as well as greater disability in clinical settings (Tan et al., 2008). Recently, the anxiety literature in chronic pain has focused on the role of anxiety sensitivity and fear-avoidance beliefs in the development and maintenance of chronic pain syndromes. Anxiety sensitivity, or heightened physiological arousal to stimuli that may be perceived as threatening, has been shown to

contribute to fear of pain (Martin, McGrath, Brown, & Katz, 2007; Watt, Stewart, Lefaivre, & Uman, 2006). Subsequently, fear of experiencing pain following injury can lead to maladaptive coping styles and further avoidance of physical activities. According to the Fear Avoidance Model of Exaggerated Pain Perception (FAMEPP), initially conceived by Lethem and colleagues (1983), pain patients may develop a disuse syndrome through avoidance of activity, leading to a vicious circle of greater disability, increased pain severity, and negative affect. This model is quickly gaining support in the physical therapy literature, which has shown that fear-avoidance beliefs accounted for nearly 20% of the variance in pain-related disability in chronic LBP patients (George, Wittmer, et al., 2006). The similar concept of pain catastrophizing, or ruminative thoughts that one cannot tolerate painful situations, has also been linked to increased pain severity, though to a lesser degree (George, Dannecker, & Robinson, 2006). Thus, the presence of anxiety, particularly fear-avoidance beliefs and related cognitive coping styles, is considered a key predictor of an unfavorable prognosis and, therefore, remains an important target in successful physical therapy treatment approaches (George & Zeppieri, 2009).

When identifying psychosocial risk factors for the progression of acute pain to chronic pain cases, comorbid depression and anxiety are often named as the main predictors. Furthermore, these were two of the main psychological constructs used by Hill et al. (2008) to classify pain patients into treatment subgroups ranging from those manageable by primary care (i.e., few psychosocial correlates) to those requiring multidisciplinary care. However, there is a growing body of literature on the role of anger in pain, and how both the experience and expression of anger can impact one's pain presentation and chronicity. Despite the relative dearth of empirical research on anger in pain relative to other negative emotions, Okifuji, Turk, & Curran (1999) found that 69% of chronic pain patients endorsed some form of anger. Given

this finding, a closer examination of what defines anger as a construct, how it affects pain, and, ultimately, how it impacts treatment choices is warranted.

The Construct of Anger

Anger is a negatively-valenced emotion usually involving a sense of injustice and a desire to have the injustice resolved (Fernandez & Turk, 1995). It is comprised of both a cognitive appraisal of the situation and an action tendency, together which define the intensity and type of anger ultimately expressed. Like other emotions, there is a wide range of anger intensities, from the relatively mild (e.g., frustration and annoyance) to the more severe cases (e.g., rage), depending on the degree of wrongdoing perceived by the angry individual and the individual's reactive tendency (Ortony, Clore, & Collins, 1988). The overarching construct of anger may be further branched into the conceptually similar, yet behaviorally disparate constructs of hostility and aggression. Hostility has been defined as an enduring tendency towards making cognitive appraisals of malicious intent of others (Greenwood, Thurston, Rumble, Waters, & Keefe, 2003), while aggression is characterized by the action tendency of outward expression (e.g., fighting or damaging property due to angry feelings) (Baron, 1977). Additionally, there is a third concept related to anger labeled passive aggression, in which one expresses anger covertly through interpersonal victimization. These concepts are all inter-related and are often used interchangeably in the literature, although others argue that they capture different affective qualities, and therefore should be assessed as different constructs (Fernandez & Turk, 1995).

Within the construct of anger, the clinical literature addresses the distinction between state and trait anger, describing one's anger experience over time, and between anger-in and anger-out, which refers to anger self-regulation styles. First addressed by Spielberger et al. (1983), state anger is a transitory feeling of anger that arises due to a specific occurrence, whereas trait anger refers to more stable personality characteristics. Trait anger is often

considered to be synonymous with hostility in the literature, particularly if accompanied by antagonistic behavior (Fernandez & Turk, 1995). When anger is experienced, individuals may attempt to regulate their emotions either through suppression, commonly labeled "anger-in," or outward expression, or "anger-out." In terms of the role of anger in the pain experience, the literature is dominated by how trait anger and anger-in versus anger-out interplay to impact pain intensity, disability, and treatment outcome.

The Impact of Anger in Pain

As anger has received relatively little attention in the literature in comparison to the role of other negative emotions in pain, it is important to emphasize the unique contribution of this emotion to suffering in the pain experience. In general, the concept of "suffering" in pain has been used as the overarching term to describe the depression, anxiety, and anger patients experience as part of the motivational-affective component. Furthermore, some studies suggest that these separate negative emotions should be considered one construct as they tend to load as one factor in principle component analyses (Hirsh, Waxenberg, Atchison, Gremillion, & Robinson, 2006) or have highly correlated values (Gaskin, Greene, Robinson, & Geisser, 1992). Also, from a theoretical standpoint, it has been suggested in the psychodynamic orientation that depression is actually anger turned inwards. While this theory has not been empirically validated, there is some evidence in the pain literature to suggest that anger-in accounts for a significant proportion of variance in depression in chronic pain patients, thereby demonstrating some link between these constructs in pain (Tschannen, Duckro, Margolis, & Tomazic, 1992; Wade, Price, Hamer, Schwartz, & Hart, 1990).

Despite the interconnectivity of negative emotions frequently found in chronic pain, there is sufficient evidence to suggest that anger impacts the pain patient when controlling for other emotions (Bruehl, Chung, & Burns, 2006). For instance, Bruehl et al., (2002) found that chronic

LBP patients with increased anger-out reported greater pain intensity during an experimental ischemic pain procedure even after controlling for depression, despite the two emotions being significantly correlated. Another study involving negative emotion induction paradigms during an experimental pain procedure found that high anger expression was unrelated to general emotional expressivity, but was related to increased physiological arousal and pain (Burns, Quartana, & Bruehl, 2007). Importantly, anger seems to be particularly relevant to low back pain. Burns (2006) found that chronic LBP patients reported greater pain intensity, greater blood pressure reactivity, and slower recovery time during an anger induction than a sadness induction, even when statistically controlling for the effects of other negative affects. Thus, although it is undeniable that anger co-occurs with other negative emotions, they may still be differentially related to pain, and, therefore, may have different implications for pain treatment.

Etiology of Anger in Pain

There are several theories as to why there is such a high prevalence of anger in pain, which describe neurobiological, cognitive, and psychosocial mechanisms behind their association. The common thread of these theories deals more with the way anger is expressed than with the intensity or frequency of one's anger. For instance, the ironic processes model of anger suppression and pain, proposed by Burns, Quartana, and Bruehl (2007), suggests that anger suppression leads to greater pain intensity. This theory is based on Wegner's ironic process theory of mental control (Wegner, 1994), which essentially states that any conscious attempt to suppress unwanted thoughts will cause the individual to devote more attention to the suppressed thought through automatic cognitive monitoring processes. Thus, in the context of pain, suppression of experiential anger causes the automatic monitoring system to focus in on more instances of anger and frustration related to the pain. This theory has been empirically supported in several studies showing that individuals who were asked to consciously suppress their anger

during an anger-induction procedure reported greater pain severity (Quartana & Burns, 2007) and greater systolic blood pressure reactivity (Burns, et al., 2007) to an acute pain condition than those who were allowed to express their anger.

A neurobiological approach to explaining the connection between anger and pain is the endogenous opioid dysfunction theory, which suggests that a more expressive style of anger regulation is associated with elevated pain intensity (Bruehl, Chung, & Burns, 2006). According to this model, the relationship between anger-out and pain sensitivity is mediated by impaired overlapping opioid inhibitory systems which serve to modulate pain and emotional regulation. Furthermore, this theory postulates that high levels of anger-out trigger endogenous opioid release for those with dysfunctional systems, thereby making anger expression temporarily adaptive in emotional and physical well-being. However, over time, frequent anger expression may lead to a stressful, unsupportive environment for the individual, further establishing his or her opioid debt and subsequent difficulty in managing pain. There is substantial empirical evidence for this theory from studies that reveal that patients endorsing high anger expressivity do not experience increased pain severity during an experimental pain procedure following a naloxone (i.e., opioid block) injection as compared to a saline injection, indicating a nonresponsive endogenous opioid system (Bruehl, Burns, Chung, & Quartana, 2008; Bruehl, Chung, Burns, & Biridepalli, 2003). There is also research showing the relationship between elevated anger-out and increased pain sensitivity in acute clinical pain (Bruehl, Chung, Donahue, & Burns, 2006; Voulgari, et al., 1991) and in chronic low back pain (Bruehl, et al., 2002; Kerns, Rosenberg, & Jacob, 1994; Lombardo, Tan, Jensen, & Anderson, 2005).

Seemingly, the ironic process theory of anger suppression in pain and the endogenous opioid dysfunction theory contradict on whether elevated anger-in or anger-out is more likely to

incite or aggravate pain conditions. However, they both describe the deleterious effects of the inappropriate regulation of high trait anger on pain. Following this pattern, the state-trait matching hypothesis of anger expression states that those with high anger-out regulation style can experience a reduction in anger arousal and resulting negative physiological effects through behavioral expression of the emotion (Engebretson, Matthews, & Scheier, 1989). Furthermore, this theory posits that a trait x situation mismatch such as suppression of anger in high anger-out individuals or, conversely, forced anger expression in anger-in individuals, would lead to increased pain sensitivity in both acute and chronic pain cases. The state-trait matching hypothesis is mostly associated with the cardiac literature, which has shown that individuals with matching trait anger and an expressive anger regulation style experience improved post-stress blood pressure recovery (Faber & Burns, 1996) whereas the tendency to suppress anger is associated with carotid stiffening (Anderson, Metter, Hougaku, & Najjar, 2006). Similar findings have been demonstrated in the pain literature, showing analgesic effects of verbal and behavioral anger expression in chronic pain patients with high anger-out tendencies (Burns, Kubilus, & Bruehl, 2003) and increased pain sensitivity when anger was suppressed (Burns, et al., 2007). Interestingly, the emotion of anger, as opposed to other negative emotions, is singularly evoked in this line of research, perhaps due to the greater degree of physiological reactivity accompanying anger. Thus, the trend of research on the relationship between anger and pain seems to be less focused on the presence or absence of this emotion, but on how it is managed by the pain patient.

Finally, there is some speculation as to the impact of anger expression on patient-provider relationships. Studies have shown that pain patients with high anger-out appear hostile to physical and occupational therapists, thereby evoking negative emotional responses from these

care providers and generally alienating these working alliances (Smith & Zimny, 1988). Burns, Higdon, Mullen, Lansky, & Wei (1999) found that therapists reported their poorest working relationships with patients who were both depressed and expressed anger. Furthermore, poor patient-provider relationships have been shown to be predictive of worse compliance with treatment, which may ultimately affect treatment outcome (Sluijs, Kok, & van der Zee, 1993). This effect seems to be particularly pertinent to men, as studies on low back pain show that men who score high on anger-out measures are more likely to have higher levels of pain-related disability, more difficulties in establishing therapeutic relationships, and poorer functional outcomes when compared to women (Burns, Johnson, Devine, Mahoney, & Pawl, 1998; Greenwood, et al., 2003). Thus, although suppression of anger has been shown in several studies to be related to increased pain severity, outward anger expression may also indirectly impact one's pain condition through creating poorer working alliances with health care providers.

Given the plentiful empirical and theoretical evidence supporting the role of anger and other negative emotions in the development and maintenance of pain conditions, it is important to examine how they impact different aspects of the pain condition, namely pain intensity and disability. Disability is often a difficult construct to define, as it is composed of several factors, including performance-based functional limitations, psychological issues that compound limitations, and societal influences that may maintain or reject disability (Bair, et al., 2003; Gesztelyi & Bereczki, 2006; Truchon, 2001). Thus, a thorough assessment of pain and disability, both performance-based and self-reported ratings, become vitally important in understanding how patients and their providers view their pain and prognosis.

Among common pain conditions, low back pain is often the most targeted syndrome for disability and treatment outcome research due to its high diagnostic frequency (an estimated 65%

1-year prevalence rate in the U.S.) and resulting exorbitant direct and indirect costs (Walker, 2000). Additionally, although only 3-10% of acute back pain patients go on to develop a chronic pain condition, these individuals consume approximately 75-80% of the recourses, further highlighting the importance of early screening measures (Nachemson, Waddell, & Norlund, 2000). Current methods used to elucidate risk factors for poor treatment outcome in pain patients, specifically those with LBP, will be discussed as well as identified prognostic indicators. Most importantly, the potential contributing role of anger in this line of research will be explored.

Subgrouping of Low Back Pain Patients

The concept of patient subgrouping has become an extensively researched area for treating patients with low back pain. Patient subgrouping involves the implementation of evidence-based treatment classification systems that identify patients who may benefit from more targeted approaches designed for their specific constellation of signs and symptoms (Delitto, Erhard, & Bowling, 1995). Prior to this method, the traditional medical model emphasized use of pathoanatomical symptoms to formulate treatment; however, due to the heterogeneity of LBP cases and contributing and maintaining factors, this method was not shown to be effective (Fritz, Cleland, & Childs, 2007). In physical therapy settings, the development of multivariate clinical prediction rules (CPR) has significantly helped guide identification of treatment subgroups for LBP patients (Delitto, et al., 1995; Fritz & George, 2000). CPR's identify several factors that predict pain treatment response, such as pain duration, pain location, and spinal mobility. They are then used to classify LBP patients into one of 4 treatment categories: manipulation, stabilization, specific exercises, or traction. CPR's have been found to be useful in treatment matching procedures and, ultimately, in predicting treatment outcome (Fritz, Delitto, & Erhard, 2003).

However, a major limitation to currently published CPR's involving interventions is that they do not incorporate a thorough psychosocial assessment during the developmental phase, and are not conclusive in terms of the potential treatment approaches available for these patients (Beneciuk, Bishop, & George, 2009). For example, studies have shown that inclusion of a cognitive-behavioral intervention for fear-avoidance beliefs related to LBP has been helpful in treatment outcome (George, Fritz, Bialosky, & Donald, 2003). Furthermore, there is a large body of empirical research using psychological and affective predictors to distinguish subgroups of pain patients. For example, the Minnesota Multiphasic Personality Inventory (MMPI-2) has been repeatedly used to identify psychological and affective factors that group chronic pain patients according to pain coping styles (Riley & Robinson, 1998), risk for disability (Gatchel, Mayer, & Eddington, 2006) and surgical treatment outcome (Riley, Robinson, Geisser, Wittmer, & Smith, 1995). These studies have provided substantial evidence for the usefulness of including psychosocial factors, especially those assessing negative emotions, when attempting to empirically define subgroups of patients for further treatment plans.

There have been a variety of screening tools developed to subgroup pain patients in order to guide treatment (Dionne, et al., 2005; Duijts, Kant, Landeweerd, & Swaen, 2006; Truchon & Cote, 2005; Westman, Linton, Ohrvik, Wahlen, & Leppert, 2008). However, these measures vary substantially in terms of methodological quality, conceptual purposes, and the normative sample's pain conditions (Hill, et al., 2008). To date, there has been only one attempt at creating a comprehensive, yet brief screening tool for prognostic indicators in non-specific LBP patients that includes both physical and psychosocial scales. The Subgroups for Targeted Treatment Back Screening Tool (STarT), developed by Hill and colleagues (Hill, et al., 2008) is a brief measure designed to be used in primary care settings to delineate subgroups of nonspecific back

pain patients according to their risk of developing a more chronic pain condition. Through a non-systematic literature search and a clinical advisory panel of primary care pain specialists, these authors identified several negative prognostic indicators for continued pain, including the psychosocial constructs of fear-avoidance, anxiety, pain catastrophizing, and depression. To discriminate between low-risk patients (e.g., those who would benefit from basic primary care pain management) and high-risk patients (e.g., those who required both physical and cognitive-behavioral treatments for a favorable outcome), predictive validity was calculated using univariate receiver operating characteristic (ROC) curve statistical analyses. While the STarT tool has shown promise in identifying risk subgroups of LBP patients for further treatment-matching (Hill, et al., 2008), there are several important caveats of this measure. First, the subgroups of LBP patients were not derived using multivariate procedures, thereby not taking into account the interrelationships of the variables used in the models. Secondly, the psychosocial subscale of the screening measure may have been under-specified, given that the construct of anger or other potentially important factors were not included. Thus, the STarT tool for screening prognostic indicators in LBP patients may require further development via validation studies to ascertain its clinical utility in different patient settings.

The Potential Role of Anger in Patient Subgrouping

In accordance with the limited empirical literature focused solely on anger in acute and chronic pain, there have also been just a few studies examining this emotion's role in patient subgrouping in terms of treatment response. Kinder, Curtiss, & Kalichman (1986) found a unique effect of trait anger as a suppressor variable for male chronic pain patients, such that those who endorsed high trait anger had lower hysteria (Hy), depression (D), and hypochrondriasis (Hs) scale scores on the MMPI-2 than those who were lower on trait anger. Following theories supporting the role of suppressed anger in pain exacerbation, these authors

interpreted these results to indicate that those less willing to express their anger tend to exhibit the neurotic triad profile, whereas those who acknowledge their anger appear less psychoneurotic. It may be noted that the neurotic triad personality profile has not been found to be particularly predictive of poor treatment outcome in pain patients when compared to other high negative affect profiles (Riley, et al., 1995). Thus, more research must be done to uncover the functional relevance of anger experience and expression in the scope of one's psychosocial presentation, and how it impacts pain and disability in patients.

Despite the dearth of empirical studies examining the role of anger in patient subgrouping, there is sufficient evidence to suggest that it is a worthwhile investigation. Trait anger has been associated with perceived disability and negatively related to activity levels, independent of other negative emotions (Kerns, et al., 1994; Okifuji, et al., 1999). Furthermore, Burns et al., (1998) demonstrated that male LBP patients with high anger-out levels showed lower improvement on lifting capacity following treatment than patients who did not endorse anger. However, another study performed by this group of researchers found that suppression of hostility leads to greater pain severity and activity interference (Burns, Johnson, Mahoney, Devine, & Pawl, 1996). These findings suggest that anger in its various forms has clinical as well as theoretical importance in the development of functional difficulties for pain patients, and therefore, may be informative in treatment-matching classification systems.

Study Rationale

The current study, which aimed to identify the added utility of anger in screening and subgrouping LBP patients according to their prognostic indicators, is important for several reasons. First, this study is one of the very few examining anger in a wide range of LBP patients, and how it may contribute to treatment outcome. As previously stated, low back pain is a leading cause of disability, and, as of now, it is unclear what modifiable physical and

psychosocial factors play a role in the maintenance of this condition. Although anger is a unique part of the negative affect spectrum pain patients endorse, found both anecdotally in clinical settings and in empirical research, it has never before been included in patient subgrouping studies. Furthermore, the current research on whether expressive or experiential anger is the main factor related to pain is mixed; this study aimed to clarify this issue in terms of identifying risk factors for continued disability.

Another novel aspect of this study is the exploration of the impact of anger on treatment in a physical therapy setting. Presently, there is abundant evidence for the role of fear-avoidance beliefs in the development of chronic pain following injury (George, Dannecker, et al., 2006; Vlaeyen & Linton, 2000), but there have not been any studies on anger in this respect. This is rather surprising given the research showing a negative impact of expressive anger on working alliances between pain patients and health care providers (Burns et al., 1999), and the importance of the patient-provider interactions in adherence to physical therapy exercises (Sluijs, et al., 1993). As physical therapy has been shown to significantly improve low back pain, it is important to consider all psychosocial factors shown to affect pain, particularly when screening for treatment-matching and creating new treatment systems.

Finally, the current study is unique in that we have used empirical rather than theoretical methods to subgroup pain patients when examining the utility of the screening tool. The STarT measure, which was used in the present study to initially define risk groups, describes three subgroups of patients that are delineated based on heuristic procedures. However, many subgrouping studies emphasize the use of hierarchical cluster analyses to identify mathematically different groups of patients based on the examined variables, thereby providing more sound evidence for the division of pain patients into specific groups (Burns, Kubilus, Bruehl, &

Harden, 2001; Riley & Robinson, 1998). Thus, the current study aimed to improve upon the methods described by Hill et al. (2008) to validate the STarT tool in two ways: creating a more specified model of psychosocial variables in LBP with the inclusion of anger, and using more a rigorous methodology to define patient risk subgroups.

Specific Aims and Hypotheses

The specific aims for the current study were as follows:

1) To examine whether the three risk groups of LBP patients, as defined by the STarT tool (i.e., low risk, moderate risk, high risk for poor treatment outcome and subsequently sustained pain conditions), differed on a measure of anger in a similar pattern to other psychosocial constructs used in the STarT measure (Hill et al., 2008).

Sub-aim: To explore whether the 3 risk groups of LBP patients differed on anger regulation styles.

2) To examine whether anger contributed to predicting risk for poor treatment outcome in LBP patients after 1 month of physical therapy treatment.

3) To examine whether the addition of an anger measure to the current psychological constructs used in the STarT tool affected empirical subgrouping of patients in terms of identifying negative prognostic indicators.

Exploratory sub-aim: To explore whether empirically derived clusters of low back patients could be used to predict their 1 month physical therapy treatment outcome.

Hypotheses based on the above aims were:

1) We predicted that those who were classified as being “high risk” on the STarT tool would have higher anger scores than the low and moderate subgroups of LBP patients.

Sub-aim: We predicted that patients in the high risk subgroup would be more likely to score high on trait anger and low on anger-out measures, indicating differing anger regulation styles from their anger experience.

2) We predicted that patients endorsing high trait anger would show less improvement on the physical examination and greater self-reported disability and pain levels at the 1 month follow-up appointment than those with low trait anger.

3) We predicted that the empirical subgrouping of LBP patients with the included anger measure would be similar to that achieved by Hill et al. (2008). Thus, we predicted that there would be 3 clusters of LBP patients, showing low, moderate, and high risk for continued pain following treatment, divided by levels of physical and psychosocial prognostic indicators.

Exploratory sub-aim: We hypothesized that the clusters of LBP patients created during their baseline measurement would be useful in predicting treatment outcome at their 1-month follow-up physical therapy appointment. Thus, if we were to identify separate clusters of patients based on the prevalence of negative prognostic indicators including anger, we predicted that those in the higher risk group would show less improvement and greater disability and pain than those with low risk after one month of treatment.

CHAPTER 2
METHODS

Participants

Patients with a current diagnosis of LBP who were referred for physical therapy services were recruited for the present study. Patients were recruited from several outpatient physical therapy clinics throughout North and North-Central Florida, including the Orthopaedics and Sports Medicine Institute (OSMI) and Shands Rehab Center at Magnolia Parke in Gainesville, Florida, and several Brooks Rehabilitation Centers in Jacksonville, Florida. Inclusion criteria for this study were: (1) adults aged 18 years or older, (2) a referral to outpatient physical therapy for LBP with or without radiating symptoms of any duration, and (3) the ability to read and speak English fluently. Exclusion criteria for the study were: (1) physical or psychological disorders related to metastatic disease, visceral disease, or fracture, and (2) osteoporosis. All participants were required to provide signed informed consent prior to enrolling in the study. Financial compensation served as an incentive for participation.

Measures

The following self-report psychological questionnaires, pain assessments, and clinician-administered physical impairment measures were given to all participants at their initial physical therapy appointment. These measures were selected because they assess factors often associated with negative pain treatment outcomes. It may be noted that this study is part of a larger study examining the validation of the STarT tool in physical therapy settings, which warranted the administration of additional physical tests and psychological measures during the evaluation. However, as they are not pertinent to the current investigation and related hypotheses, they will not be described in detail here, but may be viewed in Appendix A.

Demographic and Clinical Characteristics Questionnaire

A questionnaire was administered eliciting information pertaining to the participants' age, gender, race, years of education, marital status, and employment status. Additionally, clinical characteristics of the patients' pain condition were obtained, including duration and history of pain symptoms and surgical procedures.

Subgroups for Targeted Treatment (STarT) Back Screening Tool

The STarT is a 9-item measure used to screen for back pain prognostic indicators with the intention of ultimately aiding treatment decision-making in primary care settings. An Overall score is achieved by summing items 1-9, and a Psychosocial subscale is derived by summing the scores of the bothersomeness, fear, catastrophizing, anxiety, and depression items (Items 1, 4, 7, 8, and 9) (Appendix B). Both the overall score and the psychosocial subscale are used to subdivide LBP patients into low, moderate, and high risk groups, based on their likelihood for a favorable treatment outcome in primary care. The authors described the "Low risk" group (Overall tool score 0-3) as those with few negative prognostic indicators who would benefit from standard primary care practices (e.g., analgesia, education). The "Moderate risk" group (Overall tool score >3, but Psychosocial subscale score <4) tended to endorse higher levels of physical prognostic indicators but minimal presence of psychosocial factors, and would, therefore, benefit from physiotherapy. Finally, the "High risk" group (Psychosocial subscale score ≥ 4) was found to benefit the most from combined intensive physical and psychological approaches. The full measure is presented in Appendix B.

The STarT demonstrated adequate test-retest reliability for both the overall tool score (kappa= 0.73) and the psychosocial subscale (kappa= 0.69). Cronbach's alpha ranged from 0.74 to 0.79, indicating adequate internal consistency. The measure also demonstrated adequate

predictive validity, with 78.4% of patients identified as being high risk for having poor disability outcome at their 6-month follow-up appointment. Furthermore, discriminant validity values for the measure were considered outstanding for identifying risk for disability (AUC= 0.92). However, it may be noted that the utility of the STarT tool may be limited by the lack of systematic review in item selection, thereby potentially necessitating further specification of the model.

Pain Intensity Numerical Rating Scale (NRS)

Patients were asked to rate their pain intensity using a numerical rating scale, anchored from 0 ("No pain sensation") to 10 ("Worst pain sensation imaginable"). In addition to current pain intensity, patients were asked to provide their best and worst pain intensity levels over the past 24 hours. Numerical rating scales for measuring pain intensity have been shown to have high convergent validity, to be sensitive to treatments, and are easy to administer (Jensen & Karoly, 2001).

Pain Bothersomeness

Patients were asked to rate the bothersomeness, or unpleasantness, of their LBP with the question, "In the last week, how bothersome has your low back pain been?" using one of the following responses: "Not at all," "Slightly," "Moderately", "Very Much", or "Extremely." A single question assessing pain bothersomeness has been shown to be significantly related to pain intensity, and had 80% sensitivity in identifying patients with work-related absence and health care consultations in a 6-month period (Dunn & Croft, 2005).

State-Trait Anger Expression Inventory (STAXI)

The STAXI is a 44-item questionnaire designed to measure several dimensions of anger experience and expression. Participants were asked to indicate their agreement with statements

expressing present feelings of anger (e.g., "I am burned up."), endorsement of angry traits (e.g., "I am a hotheaded person."), and actions taken when angry (e.g., "I strike out at whatever infuriates me.") on a 4-point Likert scale. Six separate dimensions may be derived from the STAXI: State Anger (STAXI-S) (i.e., intensity of anger at the time of testing); Trait Anger (STAXI-T) (i.e., dispositional anger); Anger-in (AX/IN) (i.e., tendency to suppress angry feelings); Anger-out (AX/OUT) (i.e., tendency to express angry feelings); Anger Control (AX/CON) (i.e., frequency of attempts to control anger); and Anger Expression (AN/EX) (i.e., general index of anger expression).

For the purposes of this study, we examined the Trait Anger, Anger Control, and Anger-in and Anger-out scales, as previous research indicates that these dimensions have a significant and independent association with pain intensity and chronicity (Bruehl, Chung, & Burns, 2006; Fernandez & Turk, 1995). The STAXI boasts high internal consistency, with Cronbach alpha scores of State-Trait Anger scales ranging from $\alpha = .70$ to .93, and from .73 to .80 for Anger Expression scales. Additionally, construct validity studies indicate a strong relationship between STAXI-Trait and measures of hostility, such as the MMPI Hostility subscale ($r = .59$) (Spielberger, 1988).

Fear –Avoidance Beliefs Questionnaire (FABQ)

The FABQ is a 16-item questionnaire designed to assess fear-avoidance beliefs regarding physical activity and work in pain patients, particularly those with low back pain conditions. Patients were asked to rank endorsement of beliefs (e.g., "Physical activity may harm my back") on a scale of 0 (Completely disagree) to 6 (Completely agree). Items on the FABQ are divided into Work and Physical Activity subscales to assess fear-avoidance beliefs in these two domains separately. For the current study, the FABQ Work subscale was chosen for analyses due to its

demonstrated association with current and future disability in patients with LBP (Fritz, George, & Delitto, 2001; Waddell, et al., 1993). The FABQ has demonstrated high levels of internal consistency (Cronbach's alpha= 0.88) and test-retest reliability (r= 0.95) (Waddell, Newton, Henderson, Somerville, & Main, 1993).

Spielberger State-Trait Anxiety Inventory (STAI)

The STAI is a 40-item measure assessing both transient and long-standing anxiety in adults. It is composed of two 20-item scales, one examining state anxiety, or how anxious the respondent is in the given moment, and one for trait anxiety, or one's dispositional anxiety levels. For the purposes of this study, only trait anxiety was measured, as it is more closely related to disability following pain (Hadjistavropoulos, Asmundson, & Kowalyk, 2004). Participants were asked to indicate their agreement with various statements (e.g., "I worry too much over something that really doesn't matter.") on a 4-point Likert scale ranging from 1 (Almost Never) to 4 (Almost Always). The STAI-Trait has demonstrated high internal consistency (Cronbach's alpha= .90) and has been used extensively in research and clinical practice.

Patient Health Questionnaire- 9 (PHQ-9)

The PHQ-9 is a 9-item measure used to measure depression in medical settings. Participants were asked to rate the frequency with which they experience each of the 9 DSM-IV criteria for clinical depression on a 4-point Likert scale, ranging from 0 (Not at all) to 3 (Nearly everyday). The PHQ-9 has demonstrated strong test-retest reliability (r= 0.84) and internal consistency (Cronbach's alpha = .89) when used in primary care settings, and is considered a valid measure for depression in clinical samples (Kroenke, Spitzer, & Williams, 2001).

Roland-Morris Disability Questionnaire (RMDQ)

The RMDQ is a 24-item measure used to assess functional status of patients with LBP (Roland & Morris, 1983). Patients were asked to select statements describing different functional limitations associated with LBP that apply to their current physical abilities (e.g. "I sleep less because of the pain in my back."). The RMDQ has been shown to have good criterion-based construct and discriminant validity (Baldwin, Butler, Johnson, & Cote, 2007), as well as well-established internal consistency (Cronbach's alpha = 0.84 to 0.93) (Roland & Fairbank, 2000). The RDMQ was chosen over other disability measures, such as the Modified Oswestry Disability Questionnaire (Fairbank, Couper, Davies, & O'Brien, 1980; Fritz & Irrgang, 2001) because it has been shown to be a more sensitive measure in populations with lower levels of disability (Roland & Fairbank, 2000). As LBP patients were recruited from outpatient physical therapy centers, they are more likely to have low to moderate levels of physical disability.

Physical Impairment Index

In addition to the above psychosocial measures and pain assessment tools, a Physical Impairment Index (PII) was used to establish a clinician-guided measurement of physical impairment in the LBP patients. The PII consists of 7 physical examination tests routinely implemented in a physical therapy examination for patients with low back pain. Each test is scored as being either "positive" or "negative" based on published cut-off values (Waddell, Somerville, Henderson, & Newton, 1992). The overall PII score ranges from 0-7, with higher scores indicating greater levels of physical impairment. Adequate reliability has been reported for individual items of the PII and convergent validity has been supported via correlations with disability in patients with chronic low back pain (Waddell, et al., 1992) and acute low back pain

(Fritz & Piva, 2003). The 7 physical functioning tests included in the PII are: (1) flexion range of motion, (2) extension range of motion, (3) lateral flexion range of motion, (4) straight left raise range of motion, (5) spinal tenderness, (6) bilateral active straight leg raise, and (7) active sit-up. All baseline physical examinations were performed by trained, licensed physical therapists.

Procedures

All research procedures took place within the confines of one of the physical therapy clinics employed in this study. Licensed physical therapists were requested to ask potential participants whether they would like to take part in the study at the time of their initial evaluation. The licensed physical therapists then obtained informed consent from all study participants via signed documentation on an informed consent form, which includes information about the study procedures, duration of the study, and possible risks and benefits of participation.

Following informed consent procedures, participants were asked to complete a packet of intake questionnaires and undergo a routine physical examination, the details of which are outlined above. Completion of all included measures and the physical examination was, on average, 2 hours in duration. Patients were then provided with a 4-week treatment plan by their physical therapist based on their individual symptoms. Importantly, treatments were not standardized in this study, and there were no experimental controls or randomization procedures included. The physical therapist involved in the treatment of an individual study participant determined the appropriate interventions to be administered based on his or her professional opinion, which is typical in physical therapy practice. Essentially, treatments were not standardized and a control group was not employed in this study so as to not compromise the standard of care for the LBP patients, following ethical practice guidelines.

After four weeks, patients were asked to return to their clinic for an abbreviated follow-up assessment. Adherence to the patients' individualized treatment plans was not necessary for re-evaluation in this study. Specifically, patients were re-administered the Physical Impairment Index, Patient Satisfaction measurement, ODQ, RMDQ, PCS, FABQ, STAXI, and pain intensity and bothersomeness evaluations (Appendix A). All data collected was stored in a secure electronic database. Notably, this study only intended to address measurements taken during the baseline assessment and at the 4-week follow-up appointment. Participants were also asked to attend an additional 6-month follow-up appointment, although data collected from this session is beyond the scope and purpose of the current study.

Statistical Analyses

1) Power analyses. Power analyses were conducted to determine the number of participants needed to detect a sizable effect when using the STAXI subscales as the key outcome variables. It may be noted that, due to the different analyses required to test the hypotheses of this study, several methods were used to estimate the needed sample size. The final sample size was based on the most conservative value achieved in order to maximally power the study. Kerns, Rosenberg, & Jacobs (1994) found a unique effect size of R^2= .41 and power over 0.95 when examining the impact of anger-in on pain interference in chronic pain patients. A similar effect size (R^2= .39) was achieved by Nicholson, Gramling, Ong, & Buenaver (2003) when examining differences between anger levels on the STAXI in headache patients versus healthy controls, after controlling for depression and anxiety. These findings suggest that with a power set at 0.80 and an alpha value of 0.05, a total sample size of 54 subjects would be sufficient to obtain a similar effect size for group differences. It further shows the general sensitivity of the STAXI measures to group and treatment effects. However, to determine patient subgroups (Specific Aim 3), a sample size of N= 80 to 100 was needed to allow for cluster analyses to be built with 9

variables (5 psychological variables represented in the STarT tool and 4 anger subscale scores), with no less than the suggested 5-10 subjects per variable. Thus, recruitment of 80-100 fulfilled statistical requirements needed to perform a cluster analysis, as well as adequately power the study based on previous work using the STAXI to examine the relationship between anger and pain.

2) Descriptive statistics. Means and standard deviations were calculated for continuous demographic and clinical variables (e.g., age, years of education, and pain duration), and frequency tables were established for categorical demographic and clinical variables (e.g., gender, race, marital status, and employment status).

3) To examine whether the heterogeneous sample of LBP patients differed on measures of anger (Specific Aim 1), we first divided our sample into 3 groups: Low risk, Moderate risk, and High Risk, based on their STarT screening tool scores. One-way analyses of variance (ANOVAs) were then used to compare groups on their anger experience and regulation styles, as measured by the trait anger (STAXI-T), anger-in (AX/IN), and anger-out (AX/OUT), and anger control (AX/CON) subscales of the STAXI. Additionally, scores of other mood measures that have been shown to impact pain prognosis, namely the PHQ-9, STAI-T, and FABQ- Work Scale (FABQ-W), were added as covariates to investigate whether anger was a unique contributor to outcome risk grouping, separate from depression, trait anxiety, and fear-avoidance beliefs, respectively.

4) To examine whether anger uniquely contributed to treatment outcome in LBP patients after treatment (Specific Aim 2), a multiple regression analysis was conducted with the anger subscale scores (STAXI-T, AX/IN, AX/OUT, and AX/CON) and other mood measure scores (PHQ-9, STAI-T, and FABQ-W) as the independent variables, and the patients' Physical

Impairment Index (PII) score at their one month follow-up appointment as the dependent variable. Additionally, multiple regressions using these dependent variables were conducted with patients' self-reported disability levels on the RMDQ as the independent variable in order to further understand the relationship between anger and patient perceived disability levels. Parallel analyses were also conducted with patients' self-reported pain intensity as the independent variable. Regression diagnostics were performed to assess for multicollinearity between the predictor variables on all multiple regression analyses.

5) To examine whether the addition of anger to the current psychosocial constructs used in the development of the STarT tool affects empirical subgrouping of patients (Specific Aim 3), a hierarchical agglomerative cluster analysis (Ward's method, squared Euclidian distance) was employed. The 5 psychosocial items used in the STarT tool (bothersomeness, pain catastrophizing, fear-avoidance beliefs, trait anxiety, and depression) were represented by the STarT Bothersomeness item, total PCS score, total FABQ-Work Scale score, STAI-Trait score, and PHQ-9 Total Score, respectively. From the STarT measure, only the Bothersomeness item could be entered as an independent variable in the cluster analysis, because the rest of the individual psychosocial items on the STarT are not continuous variables. However, the additional psychosocial indicators used in STarT were derived from similar measures as the ones employed in this study, and therefore, may be accurately captured by their total scores (Hill, et al., 2008). Additionally, the 4 anger subscales of the STAXI (STAXI-T, AX/IN, AX/OUT, and AX/CON) were entered into the cluster analysis, totaling 9 variables. The number of clusters retained were determined through assessing the change in agglomerative coefficients at any given step, with substantial increases denoting cluster formation (Hair, Anderson, Tatham, & Black, 1995). Following cluster analyses, classification accuracy was evaluated using a

discriminant function analysis. We also performed a chi-square test to compare the categorical composition of the patient subgroups achieved by Hill et al. (2008) with that derived from our cluster analysis.

6) To examine whether the empirically-derived subgroups of LBP patients were useful in predicting treatment outcome at their follow-up evaluation (Exploratory Sub-aim), Repeated Measures ANOVAs (rmANOVAs) were conducted. The within-subjects variable in this analysis was time (i.e., baseline measurement vs. one month follow-up) and the between-subjects variable was group (i.e., patient cluster placement). Separate rmANOVAs were conducted for the (1) PII, (2) RMDQ, and (3) pain intensity level as the dependent variable, indicating performance-based impairment, patient-perceived physical impairment, and pain intensity.

CHAPTER 3
RESULTS

A total of 106 LBP patients were recruited for the study, with 103 LBP patients fully completing the baseline protocol, and 87 participants (84.47%) fully completing the 4-week follow-up protocol, either through mail-in (N=13) or on-site (N= 74) evaluations. There were no differences found between methods of follow-up on outcome variables of pain intensity or patient-rated disability or on self-report psychosocial questionnaires at α=.05. Patients included in the study provided informed consent prior to participation. Demographic variables as well as clinical information (e.g., pain duration and intensity) are presented in Table 3-1. Fifty percent of participants reported having pain for 90 days or less, 11.8% of participants reported having pain for 91-180 days, and 38.2% indicated being in pain for 181 days or more. Fifty-six participants (54.4%) reported having a prior history of LBP, and 17 (16.5%) participants reported having a history of surgery for LBP. The mean number of physical therapy sessions completed by the four-week follow-up evaluation was M= 6.82, SD= 2.73, and ranged from 1 session to 12 sessions. There were no significant differences found in terms of outcome variables (e.g., physical impairment, patient-rated disability, or pain intensity) or risk outcome grouping according to the STarT measure between physical therapy recruitment sites at α= .05. Normality assumptions were tested and met for all data; therefore, parametric procedures were used in all subsequent analyses.

Aim 1: Comparison of STarT Risk Groups on Anger Variables

The division of participants according to the STarT measure is presented in Table 3-2, and psychosocial characteristics of each STarT group are presented in Table 3-3. One-way ANOVAs and chi-square tests did not reveal significant differences in demographic variables or

in duration of pain symptoms between risk groups. However, there was a significant relationship between the presence of low back pain history and STarT risk grouping, such that those who fell in the High Risk group were more likely to report having prior episodes of low back pain, χ^2 (2)= 8.36, $p<.05$. Correlations between all the psychosocial predictors and outcome variables are presented in Table 3-4. Correlations between the psychosocial variables ranged from .01 to .60, with the strongest relationship existing between anger-out and trait anger, similar to values reported by Spielberger (1988).

One-way ANOVAs using planned comparisons revealed a difference in trait anger between groups [$F(1,102)= 10.55$, $p<.01$]. Individual contrasts show a significant difference between all three groups, such that the Low Risk group endorsed less anger than the Medium Risk group [$t(99)= 2.53$, $p<.05$], and the Medium Risk group endorsed less anger than those identified as High Risk [$t(99)= 2.23$, $p<.05$]. However, when controlling for other mood variables (depression, anxiety, and fear-avoidance beliefs as measured by the PHQ-9, STAI-Trait, and FABQ-W respectively), trait anger was no longer significantly different between risk groups [$F(2,95)= 2.03$, $p>.05$]. Trait anxiety held the only significant relationship in the model [$F(1,95)= 4.33$, $p<.05$], indicating an influence of anxiety on trait anger within risk groups, although the two mood variables are only modestly correlated ($r= .32$).

In terms of anger regulation styles (Anger-in versus Anger-out), planned comparisons did not reveal a significant difference between risk groups at $\alpha=.05$. Notably, there was a trend towards significance for a relationship between risk groups and anger-in when only anger measures were examined [$F(1,101)= 3.88$, $p=.05$], such that the Medium and High Risk groups combined showed a greater tendency towards an internalized anger expression style than the Low Risk group [$t(99)= 1.60$, $p=.11$]. However, similar to trait anger, when controlling for trait

anxiety, the effect of anger-in was no longer close to significance. There was a moderate correlation between anger-in and trait anxiety (r= .47).

Anger Control (AX/Con) was the only anger variable that significantly differed between groups [$F(1,101)$= 6.86, p<.01], and then remained significant when controlling for other psychosocial variables, although the effect size was notably low [$F(2,94)$= 3.26, p<.05, η_p^2= .07]. Sidak-adjusted pairwise comparisons revealed that individuals in the Low Risk group indicated greater anger control abilities (M= 26.13, SD= 4.49) than those in the High Risk group (M=22.93, SD= 5.15). However, it may be noted that trait anxiety showed a stronger association to risk grouping when included in the model, $F(1,94)$= 29.23, p<.01, η_p^2= .24. There was also a moderate correlation between anger control and trait anxiety (r=.48).

Aim 2: The Contribution of Anger Variables to Treatment Outcome

Regression diagnostics were performed on all multiple regression analyses conducted, and did not indicate excessive multicollinearity between independent variables. For all regression models, assumptions of homoscedasticity and linearity of standardized residuals were met, and independence of residuals was confirmed through the Durbin-Watson statistic. Furthermore, the averages of variance inflating factors (VIF) were not substantially greater than one, and were all under 10, and tolerance was well above 0.2, suggesting the absence of excessive collinearity according to published guidelines (Field, 2005).

To assess the unique contribution of anger to treatment outcome across all participants, a hierarchical regression model was used, with the anger variables (STAXI-T, AX/IN, AX/OUT, and AX/CON) entered in the first step, and other psychosocial variables known to impact treatment outcome entered in the second step for all three outcome variables. Results indicate that neither anger variables alone, nor anger in addition to other psychosocial symptoms predicted pain intensity ratings at their 4-week follow-up evaluation, yielding an insignificant

overall model, $F(7,75)=.85$, $p>.05$, $R^2=.07$. The model used to predict performance-based disability, as measured by scores on the Physical Impairment Index (PII), was significant only after the addition of other mood variables [$F(7,63)= 2.30$, $p<.05$], shown in Table 3-5. Specifically, fear-avoidance beliefs held the greatest weight in the model, $t(63)= 3.46$, $p<.001$. Non-anger psychosocial variables explained an additional 17.2% of the variance in PII scores above anger variables alone, yielding a complete model that accounted for 20.4% of the variance. Similarly, anger alone did not significantly predict patient-rated disability as measured by the RMDQ, although a trend for anger-in emerged, $t(73)= 1.82$, $p=.07$. However, the other psychosocial variables held a stronger relationship to disability when added, yielding a significant full model, $F(7,73)= 3.27$, $p<.01$. The work items on the FABQ also held the greatest influence in this model, $t(73)= 3.08$, $p<.01$. As shown in Table 3-6, the complete model explained 23.9% of the variance, which was 16.5% greater than when the anger variables were entered alone.

Aim 3: Empirical Grouping of Low Back Pain Patients

Hierarchical agglomerative cluster analyses (Ward's method, Euclidian distance) were used to examine subgrouping of patients based on psychosocial risk factors, and most closely resulted in a 2 group division. Patient cluster characteristics are presented in Table 3-7. Independent-samples t-tests and Pearson's chi-square tests revealed that the two clusters did not differ significantly on clinical variables (e.g., pain symptom duration, surgical history, prior episodes of back pain) or on demographic variables, although it may be noted that analyses for race and employment were underpowered and may not have detected a meaningful effect. As shown in Table 3-8, the groups appeared to divide across all psychosocial variables, creating a group in which patients endorsed greater psychosocial symptoms ($N= 17$) and a group with lower psychosocial symptom endorsement ($N=81$). Of note, scores on the AX/CON indicate Anger

Control, in which higher scores are related to more adaptive management of angry emotions. Discriminant function analysis revealed that 96.9% of cross-validated grouped cases were correctly classified. An examination of the factor loadings for each variable reveal that scores on the FABQ-W (.58), PHQ-9 (.56), and PCS (.55) were the most relevant in differentiating the clusters, whereas STAI-T (.28), AX/IN (.26), STAXI-T (.19), bothersomeness (.18), AX/OUT (.10), and AX/CON (-.05) held substantially less influence.

Independent samples t-tests were conducted to examine the relationship between the empirically-derived subgroups and outcome measures of patient-rated disability (RMDQ), performance-based impairment (PII), and pain intensity at baseline. Results, shown in Table 3-9, revealed significant differences in all three measures between groups. The groups differed on the RMDQ [$t(96)= 4.36$, $p<.001$], such that the group with lower psychosocial symptom endorsement indicated lower disability scores than those with higher psychosocial risk factors. Similarly, the lower psychosocial symptom group had lower baseline scores on the PII, indicating less performance-based impairment, $t(95)= 2.34$, $p<.05$. Finally, those with lower psychosocial symptoms reported lower pain intensity than those with higher psychosocial risk factors, $t(96)= 2.98$, $p<.01$.

Chi-square tests were performed to examine the relationship between the division of our sample according to scores on the STarT measure and the two-group solution derived from the cluster analysis. Results indicated a highly significant relationship [$\chi2(2)= 12.69$, $p < 0.01$] suggesting related categorical composition of patient subgroups, despite the addition of anger variables in the cluster analysis.

Given that the STarT measure divides patients into three risk groups depending on severity and variety of psychosocial variables, the three cluster solution was also examined. Results

yielded groups based upon high (N= 17), moderate (N= 37), and low (N= 44) endorsement of psychosocial variables, similar to the STarT group division, with 87.8% of cross-validated cases correctly classified. Interestingly, FABQ-W scores was the only psychosocial variable that did not follow the division, as the lowest group reported higher fear-avoidance beliefs than the moderate group. One-way ANOVAs and chi-square analyses did not reveal significant clinical (e.g., duration of pain symptoms, surgical history, prior episodes of back pain) or demographic differences between the three groups. In comparing the three groups on treatment outcome variables, a one-way ANOVA revealed significant differences in RMDQ [F(2,97)= 13.51, p<.01] and pain [F(2,97)= 8.16, p<.01]. Sidak-adjusted multiple comparisons indicated significant differences between all three clusters on the RMDQ, such that those in the high psychosocial risk group reported the greatest disability, and those in the moderate group reported higher disability than those in the low group. However, for pain intensity, there were only significant differences between the high (M= 6.59, SD= 1.43) and low (M= 4.59, SD= 1.94) psychosocial risk factor groups, and between the low and moderate (M= 5.67, SD= 1.87) psychosocial symptom endorsement groups. Thus, the moderate and high psychosocial risk groups did not differ significantly on pain. Scores on the Physical Impairment Index were not significantly different between groups at α=.05.

In comparing the two-cluster versus the three-cluster solution, it appears that the data more closely follows a two group division, as evidenced by the excellent classification accuracy and significant relationships to all three outcome variables. Thus, the two cluster solution was used for the remainder of the analyses.

Exploratory Aim: Examining Treatment Outcome in Relation to Patient Subgroup

In examining the relationship between the two-group cluster solution of LBP patients and scores on the Physical Impairment Index, results indicated a significant effect of testing occasion

on PII scores [$F(1,67)= 18.72$, $p<.001$, $\eta_p^2= .22$] such that both groups had lower performance-based physical impairment scores at 4 weeks. There was a trend towards significance for the main effect of group [$F(1,67)= 3.82$, $p=.06$, $\eta_p^2= .05$], indicating a tendency for patients with lower psychosocial risk factors to have lower physical impairment at both time points. There was not a significant interaction effect of time and group membership on impairment.

In terms of patient-rated disability, results revealed a significant effect of time and group. Thus, after 4 weeks of treatment, both subgroups of patients reported lower disability [$F(1,77)= 39.14$, $p<.001$, $\eta_p^2= .34$]. Also, those who fell in the low psychosocial symptom endorsement group had lower scores overall on the RMDQ than those with greater psychosocial symptoms [$F(1,77)= 17.07$, $p<.01$, $\eta_p^2= .18$]. Results also yielded a trend towards significance for the interaction of time and group [$F(1,77)= 3.45$, $p=.07$, $\eta_p^2= .04$], such that those in the higher psychosocial risk group showed a tendency towards greater decreases in RMDQ scores at the 4-week follow-up evaluation than those in the lower risk group.

Similarly, there was a significant effect for time and group for pain intensity, such that both groups experienced less pain after four weeks of treatment [$F(1,79)= 64.61$, $p<.001$, $\eta_p^2= .45$], and those with less psychosocial symptoms reported less pain overall [$F(1,79)= 4.05$, $p<.05$, $\eta_p^2= .05$]. Results did not show significant interactional effects of group membership and testing occasion on patients' pain ratings. Means and standard deviations of outcome variables for the two groups over both testing times are presented in Table 3-10.

Table 3-1. Descriptive Data

Demographic/ Clinical Variable	*N*	
Age, in years *M(SD)*	103	40.48 (13.84)
Education		
7-12 years	22	21.4%
12-16 years	67	65.0%
16+ years	14	13.6%
Sex		
Male	40	38.8%
Female	63	61.2%
Race		
White	76	73.8%
Black/ African-American	18	17.5%
Asian	4	3.9%
Pacific Islander	3	2.9%
More than one race	2	1.9%
Marital Status		
Single	34	33.0%
Partnered/Married	59	57.3%
Divorced	9	8.7%
Widowed	1	1.0%
Employment Status		
Employed	66	64.1%
Unemployed	31	30.1%
Retired	6	5.8%
Recruiting Clinic		
OSMI	27	26.2%
Magnolia Parke	41	39.8%
Brooks Rehabilitation Centers	35	33.9%
Average Pain Intensity Rating *M (SD)*	103	5.41 (1.96)
Duration of Pain Symptoms, in days *M (SD)*	102	508.05 (1101.68)

Table 3-2. Descriptive Data for STarT Risk Groups

	STarT Risk Group		
	Low Risk (*N*=39)	Medium Risk (*N*=34)	High Risk (*N*=30)
Age, in years *M (SD)*	39.26 (14.28)	42.74 (12.96)	39.50 (13.65)
Education			
7-12 years	9	4	9
12-16 years	24	23	20
16+ years	6	7	1
Sex			
Male	18	12	10
Female	21	22	20
Race			
White	29	24	23
Black/ African-American	9	6	3
Asian	1	1	2
Pacific Islander	0	2	1
More than one race	0	1	1
Employment Status			
Employed	25	25	16
Unemployed	13	5	13
Retired	1	4	1
Duration of Pain Symptoms, in days *M (SD)*	495.34 (883.23)	497.76 (1331.32)	535.80 (1101.70)
History of Low Back Pain			
Yes	15	19	22
No	24	18	8

Table 3-3. Psychosocial Characteristics of STarT Risk Groups

	STarT Group *M (SD)*		
Psychosocial Symptom	Low Risk Group	Moderate Risk Group	High Risk Group
FABQ-W	10.64 (10.38)	12.50 (10.53)	15.60 (12.04)
PHQ-9	3.92 (4.26)	6.79 (5.10)	12.23 (6.43)
STAI-Trait	33.49 (7.71)	35.76 (10.26)	38.67 (10.06)
STAXI-Trait	13.90 (3.80)	14.74 (3.60)	17.37 (5.51)
AX/IN	13.87 (4.24)	14.62 (4.29)	16.03 (4.88)
AX/OUT	12.82 (3.17)	12.74 (2.51)	13.67 (3.38)
AX/CON	26.13 (4.49)	25.03 (5.25)	22.93 (5.15)

FABQ-W: Fear Avoidance Beliefs Questionnaire- Work Scale, PHQ-9: Patient Health Questionnaire, STAI-T: Spielberger State-Trait Anxiety Inventory- Trait Scale, STAXI-Trait: State-Trait Anger Expression Inventory- Trait Subscale, AX/IN: Anger-in Subscale, AX/OUT: Anger-out Subscale, AX/CON: Anger Control Subscale

Table 3-4. Correlations between Psychosocial Predictors and Outcome Variables

	Pain	PII	RMDQ	FABQ-W	PHQ-9	STAI-Trait	STAXI-Trait	AX/IN	AX/OUT	AX/CON
Pain	1.0									
PII	.23[a]	1.0								
RMDQ	.60[b]	.41[b]	1.0							
FABQ-W	.32[b]	.19	.42[b]	1.0						
PHQ-9	.39[b]	.26[b]	.50[b]	.32[b]	1.0					
STAI-T	.15[b]	.12	.25[a]	.20[a]	.46[b]	1.0				
STAXI-T	.06	.01	.10	.04	.32[b]	.31[b]	1.0			
AX/IN	.01	.06	.13	.07	.35[b]	.47[b]	.52[b]	1.0		
AX/OUT	.02	.07	.11	.01	.14	.34[b]	.60[b]	.31[b]	1.0	
AX/CON	-.26[b]	-.12	-.29[b]	-.01	-.17	-.48[b]	-.28[b]	-.12	-.45[b]	1.0

PII: Physical Impairment Index, RMDQ: Roland-Morris Disability Questionnaire
a= $p<.05$
b= $p<.01$

Table 3-5. The Effect of Anger and Other Psychosocial Variables on PII

Model: PII Score	B	SE B	β
Step 1: Anger variables only[a]			
STAXI-Trait	.04	.07	.09
AX/IN	.06	.06	.17
AX/OUT	-.03	.10	-.05
AX/CON	-.05	.05	-.13
Step 2: Anger variables plus mood variables[b]			
STAXI-Trait	-.04	.06	-.09
AX/IN	.02	.06	.06
AX/OUT	-.02	.09	-.03
AX/CON	-.03	.05	-.09
FABQ- Work Scale	.07	.02	.44*
STAI-T	-.01	.03	-.05
PHQ-9	.01	.04	.04

a: Model accounted for 3.2% of the variance in PII, $F(4,66)= 0.55$, $p=.70$.
b: Model accounted for 20.4% of the variance in PII, $F(7,63)= 2.30$, $p<.05$.
*$p<.05$

Table 3-6. The Effect of Anger and Other Psychosocial Variables on RMDQ

Model: RMDQ Score	B	SE B	β
Step 1: Anger variables only[a]			
STAXI-Trait	.03	.20	.02
AX/IN	.31	.17	.25+
AX/OUT	-.34	.28	-.19
AX/CON	-.17	.14	-.15
Step 2: Anger variables plus mood variables[b]			
STAXI-Trait	-.04	.18	-.03
AX/IN	.28	.18	.22
AX/OUT	-.18	.26	-.10
AX/CON	-.19	.16	-.17
FABQ- Work Scale	.18	.06	.34*
STAI-T	-.11	.09	-.18
PHQ-9	.15	.11	.17

a: Model accounted for 7.3% of the variance in RMDQ, $F(4,76)= 1.51$, $p=.21$.
b: Model accounted for 23.9% of the variance in RMDQ, $F(7,73)= 3.27$, $p<.01$.
*$p<.05$
+$p<.10$

Table 3-7. Descriptive Data for the Two-Group Cluster Solution of LBP Patients

	Cluster Solution	
Demographic	Low Psychosocial Symptom (*N*=81)	High Psychosocial Symptom (*N*=17)
Age, in years	39.84 (14.30)	42.00 (11.36)
Education		
7-12 years	15	4
12-16 years	53	12
16+ years	13	1
Sex		
Male	32	6
Female	49	11
Race		
White	61	13
Black/ African-American	15	0
Asian	2	2
Pacific Islander	2	1
More than one race	1	1
Employment Status		
Employed	52	11
Unemployed	24	5
Retired	5	1
Duration of Pain Symptoms, in days *M (SD)*	399.41 (776.97)	950.58 (2026.82)
History of Low Back Pain		
Yes	43	11
No	38	6

Table 3-8. Psychosocial Characteristic of Cluster Division of LBP Patients

	Cluster Solution *M (SD)*	
Psychosocial Symptom	Low Psychosocial Symptoms Cluster (*N*=81)	High Psychosocial Symptoms Cluster (*N*=17)
Bothersomeness	2.55 (0.88)	3.21 (0.66)
PCS	12.43 (8.65)	32.00 (10.24)
FABQ-W	13.54 (5.55)	17.46 (4.82)
PHQ-9	5.69 (5.27)	12.46 (5.74)
STAI-Trait	33.18 (6.43)	45.58 (10.98)
STAXI-Trait	14.31 (3.68)	18.13 (5.46)
AX/IN	13.55 (3.61)	18.50 (4.80)
AX/OUT	12.65 (2.93)	14.42 (3.11)
AX/CON	25.39 (4.75)	22.54 (5.64)

Table 3-9. Treatment Outcome Differences Between the Clusters

Outcome Variable	Low Psychosocial Cluster (*N*=81) *M (SD)*	High Psychosocial Cluster (*N*=17) *M (SD)*	*t* Outcome (BL)	*p* Outcome (BL)
PII	3.55 (1.80)	4.65 (1.50)	2.34	.02
RMDQ	10.06 (5.58)	16.35 (4.50)	4.36	<.001
Pain Intensity (NRS 0-10)	5.08 (1.98)	6.59 (1.43)	2.98	.004

Table 3-10. Treatment Outcomes by Cluster Membership and Evaluation Period

Testing Occasion	Outcome Variable: PII		RMDQ		Pain Intensity (0-10)	
	Low Psychosocial	High Psychosocial	Low Psychosocial	High Psychosocial	Low Psychosocial	High Psychosocial
Baseline	3.55 ± 1.92	4.21 ± 1.25	9.58 ± 5.46	16.67 ± 4.72	4.99 ± 1.90	6.51 ± 1.51
4-weeks	2.27 ± 1.70	3.43 ± 1.60	6.47 ± 5.53	10.93 ± 5.86	3.20 ± 2.29	3.80 ± 2.41

CHAPTER 4
DISCUSSION

The current study aimed to provide an in-depth examination of the presentation and impact of anger in low back pain, particularly as it pertains to physical therapy treatment outcome. Although anger is infrequently mentioned in the literature on psychosocial determinants of pain and disability, it is a commonly noted trait of LBP patients in various healthcare settings. It has also been shown to lead to poor patient-provider relationships and subsequent unfavorable treatment outcome (Sluijs, et al., 1993). In order to bridge the gap between research and practice, the current study examined the multidimensional construct of anger in addition to other psychosocial factors used to identify risk for poor prognosis in low back pain. As physical therapy treatment has been moving towards the use of more targeted approaches based on patient classification systems, creating a well-specified measure to identify risk factors is becoming more important to the field. To this end, the Subgroups for Targeted Treatment Back Screening Tool (STarT) was developed to help clinicians identify LBP patients who may need a multidisciplinary approach to address psychological factors, and has shown promising predictive validity. The present study attempted to contribute to this line of literature, by adding anger as a possible prognostic indicator among others included in the STarT measure, thereby further specifying the model. Furthermore, this study used an empirical approach in identifying patient subgroups based on psychosocial risk factors, rather than heuristic procedures.

As initially predicted, LBP patients did differ on trait anger, such that those in higher risk groups, as classified by the STarT measure, endorsed more anger than those with lower risk profiles. However, other psychosocial variables held stronger relationships to risk grouping after being included in the model, thereby minimizing the impact of anger on group classification.

Additionally, anger regulation style, specifically anger-in, had only a marginal effect on risk grouping when measured alone, although the full psychosocial model did show significant differences between the Low Risk group and the higher risk STarT groups. These results suggest that anger may have contributed to the overall construct of psychosocial distress, as opposed to uniquely impacting STarT risk classification. This finding supports the substantial body of literature suggesting that general negative affect is related to somatic symptom magnification, and subsequently, increased pain and disability (Hirsh, et al., 2006; Watson & Pennebaker, 1989). Importantly, this line of literature does not negate the effect of any individual psychosocial or mood construct. Rather, it suggests that the experience and expression of "suffering" in LBP is multifactorial and cannot be decomposed easily.

The current study did find a significant, albeit small, effect of patient risk grouping on anger control, as patients in the Low Risk group reported greater attempts to control anger than those in the higher risk groups. While this finding was not originally hypothesized, it is not unexpected given the context of the study question. Patients in our sample scored in the 35th percentile, on average, in trait anger, indicating anger levels comparable to the general population. As our sample did not endorse particularly high levels of anger, there may have been a floor effect, thereby limiting exploration of anger regulation styles in pain. The dimension of anger control as measured by the STAXI, on the other hand, focuses more on how situational anger is managed when it is present (e.g., "I control my temper.", "I calm down faster than most people."). Thus, a significant relationship between low anger control abilities and risk for poor treatment outcome may be more substantiated in the context of situational anger to pain. This outcome is more in line with the state-trait matching hypothesis of anger in pain, which suggests that those who unsuccessfully try to control their anger tend to experience more pain. Use of the

STAXI-2, an updated version of the STAXI that includes separate scales of Anger Control-In and Anger Control-Out, in subsequent studies may help elucidate the nature of anger regulation style in response to pain (Spielberger, 1999). This updated measure may need to be validated in the chronic pain population, however, as it has not yet been implemented in published pain studies.

In addition to the inclusion of more sensitive measures of anger control, the methodology used to access anger in LBP patients may be improved in this study. Several studies have advised against the use of self-report measures of anger experience and expression due to strong covariation with general negative affect, thereby clouding variance attributable to anger alone (Burns, Quartana, & Bruehl, 2008; Quartana, Bounds, Yoon, Goodin, & Burns, 2010). In order to obtain a more accurate account of the unique contribution of anger to pain and disability, a recent study conducted by Quartana, et al. (2010) used numerical rating scales to assess self-reported anger suppression during anger and pain induction tasks. These authors found a positive association between anger suppression and pain intensity when controlling for both positive and negative emotions. Other studies using anger induction procedures have also found a strong unique effect of anger suppression on pain severity and other physiological responses (Burns, et al., 2007; Burns, Quartana, & Bruehl, 2009; Quartana & Burns, 2007). However, a different set of studies have concluded that both anger and sadness induction results in increased pain perception during experimental pain tasks (Rainville, Bao, & Chretien, 2005; van Middendorp, Lumley, Jacobs, Bijlsma, & Geenen, 2010). Thus, including an anger induction procedure in the present study may have yielded a clearer picture on the unique relationship between anger management and risk profiles in LBP patients, or if one even exists outside of generalized negative affect.

The strong relationship of trait anxiety to risk group membership was an interesting and somewhat surprising finding in the study. The presence of anxiety in chronic pain is often conceptualized as fear of pain (George, Dannecker, et al., 2006), or is subsumed under other psychosocial dimensions, such as anxiety sensitivity, fear-avoidance beliefs, and general emotional distress (Carleton, Abrams, Kachur, & Asmundson, 2009; Ryan, Gray, Newton, & Granat, 2010). However, few examine the contribution of dispositional anxiety to treatment outcome. Interestingly, recent studies have shown support for the influence of trait anxiety on the development of chronic low back pain, separate from fear-avoidance beliefs (Newcomer, Shelerud, Vickers Douglas, Larson, & Crawford, 2010). Further research must be done to explore this novel phenomenon, as it may help shape screening procedures for negative prognostic indicators in physical therapy settings.

Our study indicated a significant relationship between high trait anger and greater patient-rated and performance-based disability at the 4-week follow-up evaluation, but did not detect a unique effect above and beyond other included psychosocial factors. Furthermore, results revealed that these added psychosocial constructs, especially fear avoidance beliefs, were the main factors predicting patient-rated disability and performance-based impairment in our sample. As previously noted, anger experience and expression may have been difficult to access due to methodological constraints, and may therefore have been subsumed under the construct of overall negative affect. This proposed explanation falls in line with the notion that higher general psychosocial distress is related to risk for poor treatment outcome, which was supported in this study. Another issue to consider is that half of our sample reported having low back pain for less than 3 months and two-thirds of our sample reported having pain for 6 months or less, indicating a relatively short duration of symptoms. While the current study did not indicate a

relationship between pain duration and psychosocial factors, LBP episode duration has been significantly associated with poor treatment outcome in other studies (Dunn, Jordan, & Croft, 2010; Mallen, Peat, Thomas, Dunn, & Croft, 2007). Our study did show a significant positive association between low back pain history and outcome risk, indicating that general pain course and history may be influencing our results. Given that predictors of pain and disability prognoses may be different across settings (Dunn, et al., 2010), additional research on how clinical pain presentations can variably confound the impact of psychosocial symptoms is warranted.

The current study's findings support previous research indicating the importance of fear avoidance thoughts and behaviors in developing and maintaining disability in low back pain (George, Wittmer, et al., 2006; Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995; Waddell, et al., 1993). However, it is interesting that fear avoidance was the only significant psychosocial predictor of physical impairment and self-reported disability among those included in the model. Furthermore, the complete regression model, with anger, anxiety, depression, and fear avoidance, accounted for less than 8% in reported pain. As screening measures such as the STarT are heavily reliant on psychosocial symptoms to assess risk for poor treatment outcome, it is important to have a firm understanding of the magnitude of their effect. Several studies have emphasized caution in interpreting the relationship between psychosocial distress and disability due to low or moderate effect sizes (Estlander, Takala, & Viikari-Juntura, 1998; Gesztelyi & Bereczki, 2006; Schiphorst Preuper, et al., 2008), or the absence of significant findings when controlling for other factors (Dunn, et al., 2010). In light of the mixed findings in this line of literature, it would be interesting and worthwhile to explore the apparently dynamic combination of factors that impact pain and disability.

Although we had originally hypothesized that LBP patients would divide into three groups based on psychosocial prognostic indicators, our results more closely followed a two group division, separating patients into higher and lower psychosocial symptom endorsement. To compare to the STarT division, a three group solution was also analyzed. While patients were well-balanced between the high, moderate, and low groups, this categorization yielded slightly lower classification results and held weaker relationships to the outcome variables. On the other hand, the group sizes found in the two cluster solution were notably mismatched, as the group with lower scores on the psychosocial measures had more than four times the number of patients than those who endorsed greater symptomatology. This finding further supports the conclusion that the study sample was generally low on psychosocial distress, thereby restricting possible statistical effects. Importantly, however, by identifying the few of those with significant distress, the two-cluster solution may help single out patients who would benefit from multidisciplinary treatment options. Overall, the finding that empirical subgrouping techniques yielded two groups, as opposed to the three patient groups identified by the STarT measure, highlighted the relevance of empirical division of data over heuristic procedures. However, replication studies should be conducted with different LBP patient samples to confirm generalizability of results.

Given the pattern of results preceding the cluster analysis, it is not surprising that the anger variables did not carry as much weight in dividing the groups as some of the other psychosocial variables, namely pain catastrophizing, fear avoidance, and depression. Furthermore, the finding that the cluster analysis division and the STarT measure grouping of our sample were highly related suggests similar group composition, regardless of the inclusion of anger. While it is very possible that anger simply does not play a role in patient subgrouping, it may be that anger was one of the components within the general construct of emotional distress, as suggested by

Gaskin et al. (1992). Additionally, there is research to suggest that, in the context of clinical pain, anger is not as clearly differentiated from other psychosocial constructs when using self-report measures. As noted previously, studies examining chronic pain and anger using self-report measures included experimental pain (Bruehl, et al., 2003) or mood induction procedures (Burns, 2006) to understand the relationship between pain and anger. In clinical pain, research has shown that the lines between negative affect constructs tend to get blurred and may have state-dependent qualities that influence patient ratings (Burns, et al., 2008; Gaskin, et al., 1992). Thus, it is speculated that understanding how anger uniquely contributes to risk for poor outcome in LBP may simply require a different experimental model.

Our exploratory analysis revealed a significant effect of group membership on outcome after four weeks of treatment, such that those with higher psychosocial endorsement were more likely to have higher self-rated pain and disability in their follow-up evaluation. This finding provides some support that risk grouping according to the magnitude of psychosocial symptomatology is associated with treatment outcome, and may, therefore, be useful in guiding treatment. Notably, the effect of testing occasion was more powerful across all outcome variables, indicating that patients, regardless of their risk group, reported less pain and disability after engaging in physical therapy. Furthermore, there was a slight tendency for those with higher psychosocial risk factors to improve more over four weeks of treatment, indicating that the standard, non-targeted physical therapy course was sufficient in addressing their disability without added psychosocial intervention. Thus, these results appear to corroborate the notion that psychosocial factors may be a factor, but not necessarily the defining feature, of a poorer prognosis. However, given that our sample did not report pathognomonic symptoms of

emotional distress overall, it is currently unclear whether these findings are generalizable to the broader LBP population.

Interestingly, our results only showed a tendency towards significance for the influence of patient grouping on performance-based impairment, as measured by the Physical Impairment Index. While it may be that the potential effect was underpowered, a broader examination of the data shows that performance-based impairment generally has a weaker association to risk grouping than patient-rated disability. This finding has been supported in the literature, as a study comparing the two forms of impairment assessment found a stronger relationship between psychological variables and self-report disability measures than with performance-based measures (Schiphorst Preuper, et al., 2008). Furthermore, validation studies of the PII show rather weak relationships to psychosocial symptoms of depression, fear-avoidance and catastrophizing, ranging from .05 to .28 (Fritz & Piva, 2003). Also, other studies have shown significant differences between self-report and performance-based measures, and have concluded that assessing disabilities using multiple methods allows for a broader perspective of patient disability and functional capacity (Brouwer, et al., 2005; Lee, Simmonds, Novy, & Jones, 2001). The findings from the current study support the use of multiple, varied outcome measures when assessing for negative prognostic indicators in treatment, as focusing on one modality may inflate or, conversely, minimize potential effects.

Many of the general limitations of the current study have already been mentioned, including the methodological constraints of using self-report psychosocial questionnaires as opposed to pain- and mood- induction procedures to access these constructs. Additionally the anger measure selection could have been improved, as the updated version of the STAXI better delineates anger control styles. The comparison of the STarT measure grouping and the

empirical grouping used in the current study should be interpreted with caution, as some of the psychosocial measures used in the development of the STarT were different from those included in the cluster analyses. However, it may be noted that the measures included in the cluster analyses show high correlations with those used to develop the STarT, indicating that similar constructs were examined. Another limitation of the current study is that patients were not evaluated for past or ongoing psychological treatment or psychiatric diagnoses prior to their enrollment. This limitation is especially notable, given the low levels of psychosocial symptoms endorsed by LBP patients in the sample. Understanding patients' psychiatric histories may have clarified this finding, as well as how psychiatric treatment may contribute to risk grouping.

Although the scores on psychosocial measures were notably low across all patients, there is no apparent reason to suspect that our sample of LBP physical therapy patients were clinically or demographically different from other physical therapy clinics. Furthermore, the mean scores on the RMDQ and on pain intensity were not different from other studies investigating disability and pain in LBP recruited from physical rehabilitation centers (Cairns, Foster, Wright, & Pennington, 2003; Schiphorst Preuper, et al., 2007). Of note, the STarT measure was originally created to assess for prognostic indicators in primary care settings, and had not been used in physical therapy clinics prior to this investigation. To this end, an associated study is currently exploring the external, convergent, and predictive validity of the STarT measure in physical therapy settings, which may help clarify differences in patient risk profiles between primary care and PT settings. Nevertheless, the current study did reveal that patient subgroups differed on pain, disability, and performance-based impairment in the expected direction, demonstrating the impact of psychosocial symptomatology on outcome risk.

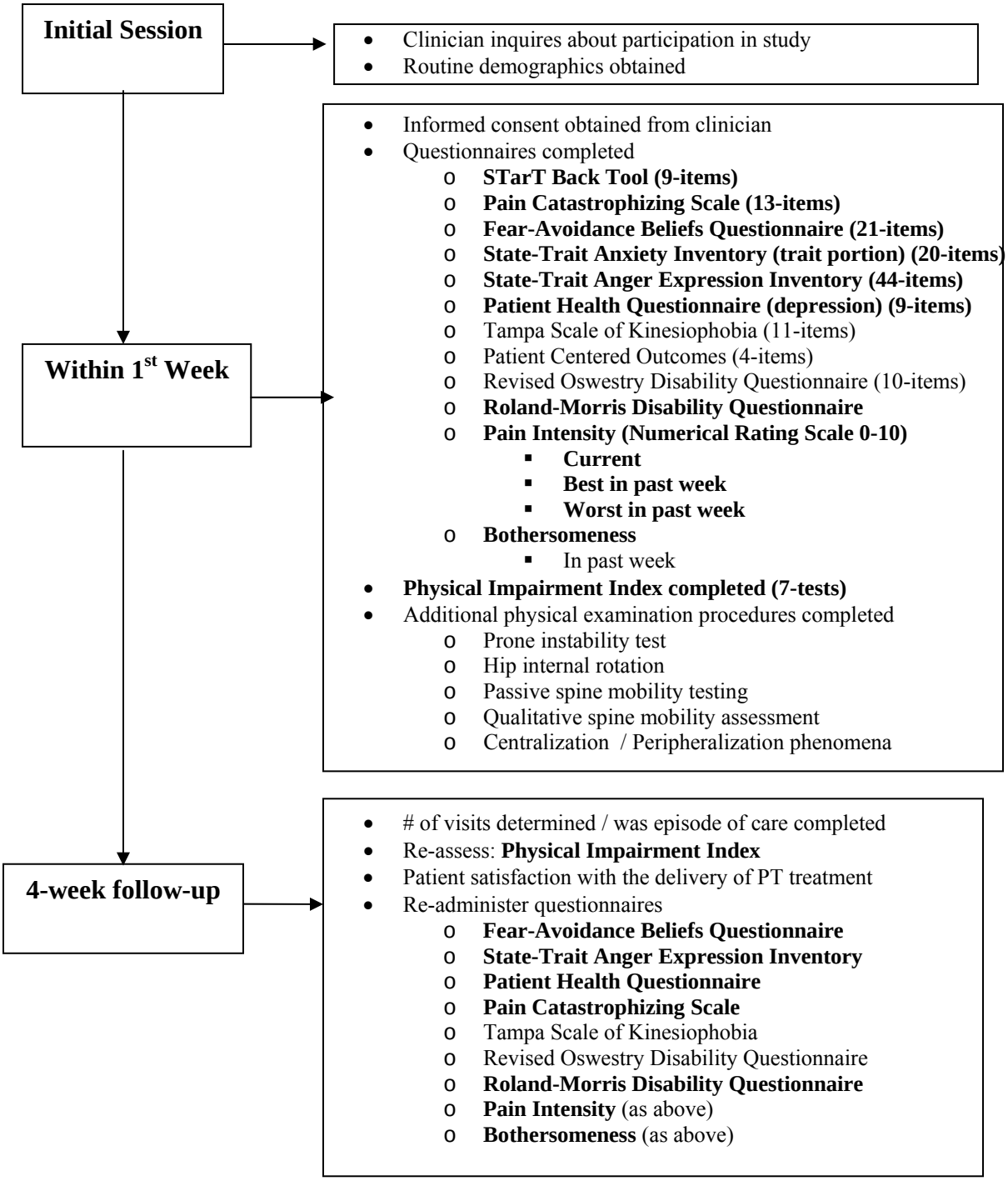
In terms of clinical implications, the results of the current study would be most useful in helping physical therapists understand the benefits and limitations of patient classification based on psychosocial screening procedures. There were a few strong relationships found between individual psychosocial variables and outcome, such as fear-avoidance beliefs, which can help direct the clinician to these specific issues in patients during treatment. However, our results also suggested that an overall construct of psychosocial distress may be impacting risk subgrouping, thereby making targeted psychosocial approaches somewhat difficult. Therefore, psychosocial risk screening tools do appear to be helpful in classifying patients, but may fall short in their ability to assist with individualized treatment plans. Regarding the impact of anger on treatment planning, the current study did not provide clear evidence whether the addition of targeted anger management protocols would be relevant to treatment outcome in the physical therapy setting. Thus, more research examining anger in physical therapy settings would help elucidate how it can affect clinical relationships and, ultimately, treatment strategies.

To this end, future studies in this area may include obtaining ratings of anger and pain immediately following a physical therapy session to better access patients' reactive anger to the exercises. Subsequent analyses may then examine how these ratings impact future physical therapy treatment results. Additionally, examining the usefulness of LBP screening measures in a long-term follow-up study may help identify the most pertinent risk factors for poor prognosis and the development of chronic LBP conditions. This investigation will be possible with the current sample, as 6-month follow-up data is currently being collected.

In conclusion, the current study yielded some interesting findings regarding the influence of psychosocial factors on treatment outcome in LBP patients. Results suggested that the patient risk groups represented different levels of psychosocial distress, although certain constructs,

specifically fear-avoidance beliefs, were especially influential. While it is evident that anger is part of the negative affect construct, the unique contribution of anger experience and expression to treatment outcome is less clear and may require additional study, preferably conducted when patients are in the midst of expressing anger. Overall, this study further supported that treatment outcome in low back pain is multifactorial, and is, therefore, difficult to predict. However, it appears that updating and implementing screening measures based on psychosocial factors may be able to help guide practice in physical therapy treatment.

APPENDIX A
FLOW DIAGRAM OF STUDY DESIGN



* This flow diagram indicates all physical and psychosocial evaluations that were administered at the patients' baseline and 1 month follow-up visits, as part of a larger parent project. Measures that are in bold font indicate those that are pertinent to the current study.

APPENDIX B
START MEASURE

For this first set of questions, please think about your back pain over the **past two weeks**

1. Overall, how bothersome has your back pain been in **the last 2 weeks**?

Not at all Slightly Moderately Very much Extremely

For each of the following, please cross one box to show whether you agree or disagree with the statement, thinking about the **last 2 weeks**.

2. My back pain has **spread down my leg(s)** at some point in the last 2 weeks.

Agree ☐ Disagree ☐

3. I have had pain in the **shoulder** or **neck** at some time in the last 2 weeks.

Agree ☐ Disagree ☐

4. It's really not safe for a person with a condition like mine to be physically active.

Agree ☐ Disagree ☐

5. In the last 2 weeks, I have **dressed more slowly** than usual because of my back pain.

Agree ☐ Disagree ☐

6. In the last 2 weeks, I have only **walked short distances** because of my back pain.

Agree ☐ Disagree ☐

7. Worrying thoughts have been going through my mind a lot of the time in the last 2 weeks.

Agree ☐ Disagree ☐

8. I feel that **my back pain is terrible** and that **it's never going to get any better**.

Agree ☐ Disagree ☐

9. In general in the last 2 weeks, I have **not enjoyed** all the things I used to enjoy.

Agree ☐ Disagree ☐

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BIOGRAPHICAL SKETCH

Anne Noelle Nisenzon is originally from Voorhees, NJ, and graduated summa cum laude from Boston University with a Bachelor of Arts in psychology. Prior to entering graduate school, she obtained functional neuroimaging research experience at Massachusetts General Hospital in Boston, MA. Subsequently, she enrolled in the doctoral program in Clinical and Health Psychology at the University of Florida, and earned her Master of Science degree in 2008 in neuropsychology. Shortly thereafter, she joined the Center for Pain Research and Behavioral Health and collaborated on numerous projects examining patient-centered outcomes in pain treatment, the use of placebo in pain, and investigating patient-provider communication using virtual human technology. After completion of a clinical internship at the University of California, San Diego and VA Healthcare System in San Diego, CA, she will commence a postdoctoral fellowship at the San Diego VA Healthcare System in behavioral medicine. Her clinical interests lie mainly in the area of behavioral medicine and tertiary care, namely treating those who are adjusting to chronic pain, injury, or other medical illnesses. Her research interests are primarily in the area of biopsychosocial treatment techniques for chronic pain in different medical populations.