TRAIT EXPECTANCIES AND PAIN-RELATED OUTCOMES IN OLDER ADULTS

by

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Dedicated to Delaney, Margot, and Brandon

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ABSTRACT

Older adults with persistent pain experience reduced physical functioning, increased disability, and higher rates of depression. Previous research suggests that different types of positive and negative expectancies (e.g., optimism and hopelessness) may be associated with the severity of these pain-related outcomes. Moreover, different types of expectancies may interact with perceived control to predict these outcomes. However, it is unclear whether different types of expectancies are *uniquely* predictive of *changes* in pain-related outcomes over time in older adults and whether perceived control moderates these relationships. The primary aims of the current study were to 1) examine how the shared and unique aspects of optimism and hopelessness differentially predict changes in pain-related outcomes (i.e., pain severity, pain interference, disability, and depressive symptoms) in older adults experiencing persistent pain over a 10-year and 2-year timeframe and 2) examine whether perceptions of control over one's health moderate these relationships. The present study sampled older adults with persistent pain who participated in a nationally representative, longitudinal study (i.e., The Health and Retirement Study) at three timepoints across a 10-year period. First, confirmatory factor analyses (CFA) were conducted to determine appropriate modeling of expectancy variables. Second, mixed latent and measured variable path analyses were created to examine the unique relationships between expectancy variables and changes in pain-related outcomes over both a 10-year and 2-year period. Finally, mixed latent and measured variable path analyses and PROCESS were used to test perceived control as moderator of the relationships between expectancy variables and changes in pain-related outcomes over time. CFA results suggested that measures of optimism and hopelessness were best understood in terms of their valence, as positive (i.e., optimism) or negative (i.e., pessimism and hopelessness) expectations. Results from path analyses suggested that only negative, not positive, expectancies were significantly associated with worsening pain severity, pain interference, disability, and depressive symptoms across both 10-year and 2-year periods. Moderation analyses demonstrated inconsistent results and difficulties with replication. However, post-hoc path analyses found that perceptions of control over one's health independently predicted some changes in pain-related outcomes over time, even when controlling for expectancies. Altogether, the current findings expand our knowledge of the associations between expectancies and pain by suggesting that negative expectancies are

predictive of changes in mental and physical pain-related outcomes across years of time. The current study also suggests that positive and negative expectancies may be related, but distinct factors in older adults with persistent pain and that health-related perceived control may be predictive of changes in pain over time. The current discussion reviews these extensions of our current knowledge in greater detail, discusses the potential mechanisms driving these relationships through a theoretical lens, and identifies the implications of this work.

INTRODUCTON

The number of older adults in the US is increasing at a rapid pace (Colby & Ortman, 2015). Unfortunately, a majority (i.e., 85.8%) of this growing population report having at least one chronic health condition (Ward, Schiller, & Goodman, 2014). One of the costliest (Simon, 2012) and most problematic health issues facing older adults is pain (Crook, Rideout, & Browne, 1984). Older adults have some of the highest prevalence rates of both acute and chronic pain (Crook, Rideout, & Browne, 1984; Fox, Raina, & Jadad, 1999; Magni, Marchetti, Moreschi, Merskey, & Luchini, 1993). Additionally, pain in older adulthood is related to worse physical functioning (Thomas, Peat, Harris, Wilkie, & Croft, 2004), increased disability and difficulties with independent living (Eggermont et al., 2014), and higher rates of mental health problems, particularly depression (Onder et al., 2005)

Physical Functioning and Depression in Older Adults with Pain

While experiencing pain at any age is unpleasant, pain in older adulthood is particularly burdensome. Pain in older adulthood is associated with notable deficits in physical functioning (Thomas et al., 2004) in a variety of areas. Older adults who experience pain report that it interferes with daily functioning at significantly higher rates than younger adults who experience pain (Thomas et al., 2004). In addition, older adults with pain engage in significantly less physical activity (Stubbs et al., 2013) and report higher rates of serious falls (Stubbs, Binnekade, et al., 2014; Stubbs, Schofield, et al., 2014) than older adults without pain. Moreover, there is a robust relationship between the severity of pain and difficulties with mobility in older adults (Eggermont et al., 2014). Specifically, with each additional reported pain area, there is a 13% increase in the chance of having a mobility disability (Shah et al., 2011). Altogether, the evidence suggests that pain in older adulthood hinders physical functioning, which may threaten independent living and reduce quality of life (Eggermont et al., 2014; Jakobsson & Hallberg, 2002).

Pain in older adulthood is also uniquely associated with depression (Bonnewyn et al., 2009). Several studies have demonstrated a link between pain severity, physical functioning, and depression in older adults (Bonnewyn et al., 2009; Mossey, Gallagher, & Tirumalasetti, 2000;

Williamson & Schulz, 1992). The worsening of pain severity and physical functioning in combination have been proposed to contribute to worsening depressive symptoms (Williamson & Schulz, 1992). Alternatively, it has also been proposed that the combination of pain severity and depressive symptoms contributes to worsening physical functioning (Mossey et al., 2000). However, there are likely to be reciprocal and cyclic relationships among pain severity, physical functioning, and depression (Bair, Robinson, Katon, & Kroenke, 2003). The reciprocal nature between depression and pain may be due to their shared biological (e.g., similar associated brain structures, neurocircuitries, and neurochemicals) and psychological (e.g., catastrophizing and learned helplessness) pathways (Robinson et al., 2009). Regardless of the mechanisms driving these relationships, depressive symptoms are present in up to 85% of patients with pain (Bair et al., 2003). Thus, pain in older adulthood is associated with uniquely devastating impacts on both physical and mental health.

Despite the significant suffering associated with pain in older adults, they are considerably undertreated for pain (Pitkala, Strandberg, & Tilvis, 2002). Older adults may be less likely seek pain treatment due to beliefs about pain and aging (Thielke, Sale, & Reid, 2012). Specifically, older adults report beliefs that pain is an inevitable part of getting older that they must accept, rather than attempt to treat (Gignac et al., 2006; Thielke et al., 2012). Despite this view, studies have repeatedly demonstrated that pharmacological, psychosocial, and physical treatments are beneficial for pain in older adults (Papaleontiou et al., 2010; Park & Hughes, 2012; Reid et al., 2008). Thus, beliefs about the inevitability of pain in older adulthood likely complicate the treatment of pain and prevent older adults from achieving relief in the future (Thielke et al., 2012). In other words, the expectations that older adults hold appear to play a critical role in the course of their pain.

Expectancies and Pain

Pain has been consistently associated with thoughts about the future (i.e., expectancies; Atlas & Wager, 2012; Garofalo, 2000; Goodin & Bulls, 2013; Jackson, Wang, Wang, & Fan, 2014; Peerdeman, van Laarhoven, Keij, et al., 2016; Peerdeman, Van Laarhoven, Peters, & Evers, 2016). In general, positive expectancies (e.g., hope, optimism, self-efficacy) have been associated with less pain severity, better physical functioning, and less depression and anxiety in those living with pain (Jackson et al., 2014; Shanahan, Fischer, Hirsh, Stewart, & Rand, 2021);

whereas, negative expectancies (e.g., catastrophizing and hopelessness) have been associated with higher pain severity, more disability, and worse mental health (Hülsebusch, Hasenbring, & Rusu, 2016; Severeijns, Vlaeyen, van den Hout, & Weber, 2001).

Optimism, defined as the general expectation that good, as opposed to bad, events are likely to happen in the future (Scheier & Carver, 1985), is a positive *trait expectancy* that has been consistently associated with pain (Basten-Günther, Peters, & Lautenbacher, 2019; Shanahan et al., 2021). Optimism is purported to contribute to more adaptive pain-related outcomes through a variety of biological and psychological mechanisms (Garofalo, 2000; Goodin & Bulls, 2013). Trait optimism has demonstrated associations with fewer specific negative expectancies, such as less catastrophizing and less negative expectancies for aging (Goodin et al., 2013; Hanssen, Peters, Vlaeyen, Meevissen, & Vancleef, 2013; Hood, Pulvers, Carrillo, Merchant, & Thomas, 2012; Wurm & Benyamini, 2014). In turn, less negative specific expectancies for pain are associated with better pain-related outcomes (Peerdeman, Van Laarhoven, Peters, et al., 2016). According to self-regulation theory (Carver & Scheier, 2001), by holding more positive specific expectancies (e.g., "My pain will be manageable enough to walk around the block"), individuals may believe that a positive future is more likely and put more effort toward this coming to fruition. Thus, optimism may be associated with better pain-related outcomes through its connection with adaptive coping strategies (Nes & Segerstrom, 2006). Applying this theory to older adults with pain, more optimistic individuals may hold more positive specific expectations that their pain will get better in the future. In turn, these positive specific expectations may motivate older adults to seek out treatment or put effort towards other ways of managing their pain.

Negative expectancies may have similar connections with pain. Hopelessness, or the absence of hope, is the belief that one does not have the capability to accomplish their future goals (Snyder et al., 1991). Specifically, hopelessness individuals may perceive that they lack goal-directed energy and the ability to develop goal-directed plans (Snyder et al., 1991).[1] Hopelessness is a widely studied negative expectancy that has been linked to depression and suicidality (Abramson, Metalsky, & Alloy, 1989; Liu, Kleiman, Nestor, & Cheek, 2015). In

[1] There are also other conceptualizations of hopelessness in the literature. Most popular is Beck's (1974) conceptualization of hopelessness as a generalized belief in a negative future. Within this study, I will focus on the conceptualization of hopelessness, or the absence of hope, according to Snyder (1991).

addition, a relationship between hopelessness and pain has been suggested through the connection between depressive symptoms and pain (Pincus & Williams, 1999). Although there have been fewer studies examining the link between hopelessness and pain, the research generally suggests that the absence of hope is associated with more severe pain intensity, more pain interference, and more depression in those experiencing pain (Hanssen et al., 2013; Hartley, Vance, Elliott, Cuckler, & Berry, 2008; Mystakidou et al., 2007; Wilson et al., 2017). In older adults, the relationship between hopelessness and pain-related outcomes has been demonstrated cross-sectionally (Bartley, Palit, Fillingim, & Robinson, 2019; Southerland, 2012). Hopelessness may relate to worse pain-related outcomes in ways like optimism. Specifically, believing in a negative future could diminish older adults' willingness to engage in efforts to reduce pain and increase the use of avoidant coping strategies (Carver & Scheier, 2001).

Although optimism and hopelessness have conceptual and empirical overlap, research has repeatedly demonstrated that these are distinct concepts. Optimism and hopelessness are structurally distinct (Fowler, Weber, Klappa, & Miller, 2017; Rand, 2009) and may influence pain-related outcomes through separate mechanisms. Peerdeman and colleagues (2016) have suggested that outcome expectancies (i.e., expectancies regarding external events and internal stimuli) and self-efficacy expectancies (i.e., expectancies regarding one's personal ability to perform future behaviors) may differentially relate to the experience of pain. Positive outcome expectancies may contribute to better pain-related outcomes through the placebo effect (Price, Finniss, & Benedetti, 2008), while self-efficacy expectancies may work through self-regulation and the promotion of active coping (Peerdeman, Van Laarhoven, Peters, et al., 2016). In relation to trait expectancies, optimism may be best conceptualized as a generalized outcome expectancy. Previous research suggests that optimism differs from other positive trait expectancies, such as hope, in that the expectation for positive futures is derived from one's expectations for the world, others, external stimuli, and the self (Carver & Scheier, 2002; Rand, 2009, 2018; Shanahan, Fischer, & Rand, 2020). In other words, optimism best captures the expectation that a positive future will happen *to* someone rather than expecting that one can *make* it happen. On the other hand, hopelessness, or the absence of hope, captures individuals' expectations regarding their ability to bring forth their own positive futures by reaching their goals (Shanahan et al., 2020). Thus, hopelessness may be best conceptualized as a self-efficacy expectancy.

Previous research has supported the notion that different types of expectancies work through separate mechanisms under various circumstances. Specifically, research has demonstrated that hope is associated with more positive specific expectancies, better performance, and increased well-being when an individual perceives some level of personal control over future outcomes (Gallagher & Lopez, 2009; Rand, 2009; Shanahan et al., 2020). In contrast, optimism is associated with more positive specific expectancies and well-being when individuals perceive a lack of control over future outcomes (Gallagher & Lopez, 2009). Shanahan and colleagues (2020) found that manipulating one's perception of control over a situation altered the strength of the association between trait expectancies and specific expectancies. In this study, only hope predicted positive specific expectancies in situations that were perceived as personally controllable; whereas, only optimism predicted positive specific expectancies in situations where individuals perceived no personal control over an outcome. In this same way, optimism may predict better pain-related outcomes through the promotion of positive specific expectancies when older adults perceive limited control over their pain. Alternately, hopelessness may predict worse pain-related outcomes through the promotion of negative specific expectancies when older adults perceive their pain as personally controllable. Thus, whether older adults perceive a sense of control over their health may alter how trait expectancies influence their pain experience.

Taken together, the research suggests that 1) positive and negative expectancies are associated with pain-related outcomes and 2) different types of expectancies may relate to the experience of pain in different ways. However, there are several major gaps in the current literature. First, much of the current literature examines the relationships between expectancies and pain-related outcomes cross-sectionally (Jackson et al., 2014; Shanahan et al., 2020). Considering expectancies are theorized to predict pain-related outcomes through the facilitation of adaptive coping (Carver & Scheier, 2001), it is necessary to test whether expectancies are *contributing to a change* in pain-related outcomes over time. However, the prognosis for chronic pain is generally poor, with 60-80% of individuals continuing to experience pain over a year after diagnosis and symptom improvement slowing over time (Costa et al., 2012; Hayden, Dunn, Van der Windt, & Shaw, 2010). Therefore, it is necessary to test whether the prospective relationships between expectancies and pain change over time or whether they remain stable. Second, it remains unclear if different expectancies (i.e., optimism and hopelessness) share associations with pain-related outcomes based on their common aspects (i.e., shared variance) or if they are differentially related to pain-related outcomes based on their unique characteristics (e.g., outcome vs. self-efficacy expectancies). Hence, there is a need for research examining the differential relationships among optimism and hopelessness with pain-related outcomes. Third, it remains unclear whether individuals' perception of control over their own health modifies the relationships between trait expectancies and pain-related outcomes. There is a need to examine whether trait expectancies are similarly associated with pain for both those who feel a strong sense of control over their health and for those who feel little control over their health. Finally, considering that older adults are largely excluded from pain research (Domenichiello & Ramsden, 2019; Paeck et al., 2014) and, yet, are disproportionally and negatively affected by pain (Crook et al., 1984), more research examining the link between expectancies and pain-related outcomes is warranted in older adult samples.

The Present Study

The overarching goal of the current study was to examine the relationships between trait expectancies and pain-related outcomes in older adults. Specifically, the current study aimed to examine the unique and shared predictive utility of trait expectancies in relation to changes in pain-related outcomes over time. The specific aims were as follows:

Aim 1

To later test whether the unique or shared aspects of trait expectancies were predictive of pain, I first needed to determine the best conceptualization of trait expectancies. Previous research has suggested that optimism and hopelessness are structurally distinct (Rand, 2009; Fowler et al., 2017). However, this research used different measurements of these concepts and drew their samples from different populations. Thus, Aim 1 was to determine the factor structure of optimism and hopelessness as measured in the current study with a sample of older adults with persistent pain.

Aim 2

Examine how the shared and unique aspects of optimism and hopelessness differentially predict changes in pain-related outcomes (i.e., pain severity, pain interference, disability, and depressive symptoms) in older adults experiencing persistent pain over a 10-year and 2-year timeframe.

Aim 3

Examine whether the relationships between trait expectancies and changes in pain-related outcomes were moderated by perceptions of control over one's health.

METHOD

Participants and Study Design

The present study used data from an existing, epidemiologic dataset called the Health and Retirement Study (HRS). The HRS is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. The HRS is a public, longitudinal dataset that has surveyed a representative sample of approximately 20,000 Americans over the age of 50 every two years since 1992. The HRS surveys older adults[2] on a variety of subjects, including health status, psychosocial variables, employment, financials, family structure, and other related outcomes.

To test the study aims, data from three timepoints were collected. As I aimed to examine the unique effects of expectancy on the trajectory of pain-related outcomes over a 10-year and 2-year period, HRS data collected during 2008, 2016, and 2018 were examined. I used the most recent datasets available to control for cross-generational effects and ensure that the results were generalizable to the current generation of older adults in the US. I created two separate samples to test my stated aims. First, Sample 1 used data collected in 2008 and 2018 and included participants who indicated that they were "often troubled with pain" in 2008. This sample was used to examine changes in pain-related outcomes across a 10-year timeframe. Second, Sample 2 used data collected in 2016 and 2018. This sample included participants who indicated that they experienced persistent pain in 2016. Sample 2 was used to examine changes in pain-related outcomes across a 2-year period.

[2] Reviews of pain in older adulthood have defined older adulthood inconsistently, with studies characterizing this period of life as beginning anywhere between 50 (Blagojevic, Jinks, Jeffrey, & Jordan, 2010; Morone & Greco, 2007; Silverwood, Blagojevic-Bucknall, Jinks, Jordan, Protheroe, & Jordan, 2015) and 65 years of age (Paeck, Ferreira, Sun, Lin, Tiedemann, & Maher, 2014; Reid, Eccleston, & Pillemer, 2015). For the purposes of this study, older adulthood was defined as ≥ 50 years of age.

Measures

Demographics

Various demographic data were collected in order to characterize the samples including participants' age, sex (i.e., male or female), sexual orientation (i.e., gay, straight, bisexual, or something else), perception of their health status (i.e., excellent health, very good health, good health, fair health, poor health), and veteran status (i.e., actively served in the military or did not actively serve in the military).[3] Respondents also reported whether they had been diagnosed by a physician with various pain disorders (i.e., any form of arthritis, osteoarthritis, rheumatoid arthritis, or injury-related arthritis) and whether they experienced persistent back pain. Participant height and weight data were collected to calculate body mass index (BMI). Finally, data were collected regarding whether participants had taken any over- the-counter pain medications or opioid medications within the past three months. All demographic variables were collected within both samples apart from sexual orientation, over-the-counter pain medication use, and opioid use as these were not measured at the 2008 timepoint.

Expectancy variables.

Optimism

Optimism was measured using a modified version of the Life Orientation Test- Revised (LOT-R; Scheier, Carver, & Bridges, 1994). Respondents indicated the extent of their agreement with three items measuring optimism and three items measuring pessimism using a 6-point Likert scale (1 = strongly disagree to 6 = strongly agree). Higher scores indicated higher levels of optimism. The modified version of the LOT-R differs from the original LOT-R in that it does not include distractor items and uses a 6-point rather than a 5-point Likert scale (Scheier et al., 1994). The LOT-R has been demonstrated as a temporally reliable and valid measure of optimism (Bryant & Cvengros, 2004; Scheier et al., 1994). Cronbach's alpha for the LOT-R was .73 in Sample 1 (2008) and .76 in Sample 2 (2016).

[3] The HRS is a nationally representative dataset which actively recruits participants of all races to match the demographic makeup of the US. However, the HRS considers participant race to be sensitive health information, restricts the use of this data, and requires special permissions to collect this information. For the purposes of this dissertation, race data could not be collected to characterize this sample.

Hopelessness

Hopelessness was measured using four items derived from Everson's (Everson et al., 1996) and Beck's (Beck, Weissman, Lester, & Trexler, 1974) scales of hopelessness. Specifically, participants answered the following questions: 1) "I feel it is impossible for me to reach the goals that I would like to strive for", 2) "The future seems hopeless to me and I can't believe that things are changing for the better", 3) "I don't expect to get what I really want", and 4) " There's no use in really trying to get something I want because I probably won't get it." Respondents indicated the extent of their agreement with these items using a 6-point Likert scale (1 = strongly disagree to 6 = strongly agree). Higher scores indicated higher levels of hopelessness. Of note, although all items are negatively worded in a way to be indicative of a poor outlook toward the future, these items have been suggested to reference the main components of Snyder's (1991) construct of hope (i.e., agency and pathways thinking; Long et al., 2020). Thus, the precise construct that these items are measuring is open for interpretation. However, because items were all negatively worded, the current study referred to this construct as hopelessness. This scale has demonstrated adequate reliability in earlier timepoints of data collection within the HRS dataset (alpha =.87 in 2004; alpha = .86 in 2006; Clarke, Fisher, House, Smith, & Weir, 2008; Long et al., 2020). In the current study, Cronbach's alpha was .83 in Sample 1 (2008) and .87 in Sample 2 (2016).

Pain Variables

Pain Severity

Pain severity was measured with a single item. Immediately after indicating that they were "often troubled by pain" participants were asked, "How bad is the pain most of the time?" Respondents answered this question using a 3-point Likert scale (1 = mild, 2 = moderate, 3 = severe). Higher scores indicated more severe pain.

Pain Interference

Pain interference was measured with a single item. Immediately after indicating the severity of their pain, participants were asked, "Does the pain make it difficult for you to do your usual activities such as household chores or work?" Respondents answered yes or no to this question. Scores of 1 indicated that individuals experienced pain interference and scores of 0 indicated that individuals did not experience pain interference.

Disability

Disability was measured through an Activities of Daily Living (ADL) scale. The HRS ADL scale measured individuals' basic abilities to personally manage their everyday physical needs. Respondents indicated whether they experienced any difficulties with 1) dressing, 2) walking, 3) bathing, 4) eating or cutting up food, 5) getting in and out of bed, and 6) using the toilet or getting up and down from the toilet due to "a health or memory problem." Respondents answered either yes or no to each of these six questions. Higher scores indicated greater disability. In the current study, disability was modeled as a latent variable with six indicators for each item listed above. The internal consistency of this scale in the current study was .81 in Sample 1 (in both 2008 and 2018) and ranged between .79-.80 in Sample 2.

Depressive symptoms.

Depressive symptoms were measured using a modified version of the eight-item Center for Epidemiologic Studies – Depression Scale (CES-D-8; (Radloff, 1977). Participants indicated whether they had experienced six items indicative of depression (i.e., feelings of depression, feelings of sadness, feelings of loneliness, restless sleep, inability to get going, feeling as if everything is an effort) and two items indicative of the absence of depression (i.e., feeling happy and enjoying life) within the past week. Items measuring the absence of depression were reverse scored. Higher scores indicated greater depressive symptoms. The modified CES-D-8 uses a dichotomous scale in which participants identify whether they did or did not experience each item. The CES-D-8 has demonstrated adequate reliability in previous waves of the HRS dataset (Gallo et al., 2006). In the current study, the CES-D-8 had a Cronbach's alpha of .81 in Sample 1 (in both 2008 and 2018) and ranged between .81-.82 in Sample 2.

The CES-D-8 has also demonstrated moderate levels of agreement with major depression as diagnosed with the Composite International Diagnostic Interview in previous waves of the HRS dataset, suggesting good validity within older adult populations (Turvey, Wallace, & Herzog, 1999). In the current sample, I tested whether the CES-D-8 was a reliable predictor of a concurrent diagnosis of major depressive disorder (MDD). An independent samples t-test suggested that participants in Sample 1 had significantly higher CES-D-8 scores if they met criteria for a diagnosis of MDD, $t(5294) = 25.17$, $p < .001$. Thus, the CES-D-8 appeared to be a valid measure of depression in the present study. For the main analyses in this study, depressive symptoms were modeled as a latent variable with eight indicators for each of the items listed above.

Perception of Control Variable.

Perception of Control over Health

Perception of control over one's health was measured with a single item. Respondents were asked "Using a 0-10 scale where 0 means 'no control at all' and 10 means 'very much control' how would you rate the amount of control you have over your health these days?" Scores on this measure ranged from 0 to 10 with higher scores indicating a perception of greater control over one's health.

Analytic Plan

Preliminary Analyses

All analyses were conducted in SPSS Version 25 and Mplus Version 8 (IBM, 2016; Muthén & Muthén, 2017a). Data were initially split into two separate datasets. Sample 1 included data from 2008 and 2018 and included older adults who indicated that they had experienced persistent pain in 2008. Sample 2 included data from 2016 and 2018 and included older adults who indicated that they had experienced persistent pain in 2016. Data cleaning and preliminary analytic procedures were identical for these two datasets.

First, participants who indicated that they did not experience persistent pain or who were under 50 years of age were removed from the sample.[4] Next, the percentage of participants who completed the HRS study at both timepoints was calculated to describe attrition. Descriptive statistics (e.g., means, standard deviations, and frequencies) and correlations were calculated for

[4] The HRS dataset includes individuals who are at or above 50 years of age and their partners. Some partners of those who are 50 or older may themselves be under 50 years of age. To conform to our population of interest, those under the age of 50 were excluded from analyses.

all measured variables. Normality and linearity of data were checked visually by examining histograms and statistically by comparing skewness and kurtosis to assumptions of normality and linearity using Kline's (Kline, 2011) guidelines (i.e., -3 < skewness < +3, -10 < kurtosis < +10).

Finally, several steps were taken to account for missing data. First, independent samples t-tests were conducted to identify any measured variables (i.e., demographic variables, expectancy variables, and pain-related variables) significantly related to attrition (i.e., $p < .01$).[5] Next, once all measured variables related to attrition were identified, I determined whether data were considered missing at random (MAR) or not missing at random (NMAR). According to Enders (2010), data are considered NMAR when the probability of attrition is due to the dependent variables themselves, even after controlling for other identified auxiliary variables associated with attrition. Thus, multiple regression analyses were conducted to test whether any pain-related outcomes significantly associated with attrition still had significant associations after controlling for other identified auxiliary variables associated with attrition. If pain-related outcomes were no longer significantly associated with attrition, the data were determined to be MAR. Then, full information maximum likelihood (FIML) was conducted in Mplus using the maximum likelihood estimation method with robust standard errors (MLR) to account for missing data as suggested by Muthén and Muthén (2017b). All analyses were run once using FIML to impute missing data for all participants and once using FIML with only participants who completed both timepoints to ensure that this estimation method did not inappropriately estimate missingness related to attrition.

Aim 1

Confirmatory factor analyses (CFA) were used to examine Aim 1. In line with previous research (Rand, 2009; Fowler et al, 2017), I first tested three competing a priori models to determine the best factor structure of optimism and hopelessness within this sample: 1) a unifactor model, 2) a correlated factors model, and 3) a hierarchical model (see Figure 1). The unifactor model assumed that all items measuring optimism and hopelessness reflected a single latent factor of one's generalized expectation. The correlated factors model assumed that optimism and hopelessness were two separate latent variables that are distinct but correlated.

[5] Due to the great number of t-tests tests being performed, a conservative p value was chosen to reduce the odds of Type 1 error.

Finally, the hierarchical model assumed that optimism and hopelessness were best modeled as two first-order latent constructs with a second-order latent construct modeled to account for the shared relationship between optimism and hopelessness (i.e., generalized expectation). Based on the findings of Rand (2009), I hypothesized that the hierarchical model would be the best-fitting model of optimism and hopelessness.

Analyses were conducted using MLR estimation method. Each model was evaluated using several fit indices, including: the chi-square statistic, the Akaike Information Criterion (AIC; Akaike, 1987), the standardized root mean square residual (SRMR; Bentler, 1995), the root mean square error of approximation (RMSEA; Steiger, 1980), the comparative fit index (CFI; Bentler, 1990), and the nonnormed fit index (NNFI; Bollen, 1989), as suggested by Hu and Bentler (1999). A non-significant (i.e., $p > .05$) chi-square statistic represented acceptable model fit. However, this statistic is sensitive to large sample sizes. Therefore, in this study, the chi-square statistic was used to compare the three competing nested models (Gerbing & Anderson, 1993). The AIC is an additional measure of fit used to compare competing models. The model with the lowest AIC value is considered the best-fitting model (Lin & Dayton, 1997). For all other indices, model fit guidelines vary (Browne, 1993; Hu & Bentler, 1999; MacCallum, Browne, & Sugawara, 1996). However, in general, "good" model fit is defined as: 1) SRMR ≤ 0.08; 2) RMSEA ≤ 0.06; 3) CFI ≥ 0.95; and 4) NNFI > 0.95 (Hu & Bentler, 1999; Kline, 2011).

If none of the identified a priori models met criteria for good model fit across the fit indices, modification indices and factor loadings were examined. If none of the suggested modification indices significantly improved the overall model fit and aligned with the theoretical understanding of these constructs, a posteriori models were created and assessed to determine appropriate measurement models of expectancy variables for Aim 2. CFAs were originally examined using 2008 optimism and hopelessness data in Sample 1. Then, once the best-fitting model was identified using 2008 data, this model was replicated using 2016 and 2018 data to ensure consistently accurate modeling of generalized expectancy variables in older adults with persistent pain.

Aim 2

Mixed-latent and measured-variable path analyses were used to test Aim 2. This model examined the unique and common associations of trait expectancy variables on changes in pain-related outcomes over time. Using the best-fitting model from Aim 1, trait expectancies at Time 1 were modeled to predict Time 2 pain variables (i.e., disability, pain interference, pain severity, and depressive symptoms). Additionally, Time 1 pain variables were modeled to predict their corresponding Time 2 pain variables. Identified covariates of each pain variable were modeled as predictors of Time 2 pain variables. All pain variables at Time 1 were freed to correlate, all pain variables at Time 2 were freed to correlate, and residual terms for identical indicators were correlated across time (e.g., Time 1 disability and Time 2 disability). Hence, this model examined how trait expectancies predicted *changes* in pain-related outcomes over time while controlling for relevant covariates. Expectancy variables, disability, and depressive symptoms were modeled as latent variables and pain interference, pain severity, and identified covariates were modeled as measured variables.

Covariates were identified by creating a mixed-latent and measured-variable path analysis with hypothesized covariates at Time 1 (i.e., age and sex) predicting disability, pain interference, pain severity, and depressive symptoms at Time 2 while controlling for previous levels of each outcome at Time 1. All pain variables at Time 1 were freed to correlate, all pain variables at Time 2 were freed to correlate, and residual terms for identical indicators were correlated across time. This model allowed for the identification of significant covariates that predict a change in each individual pain outcome of interest. Significant covariates were included in the final model.

After path models were created, model fit was examined using chi-square, SRMR (Bentler, 1995), RMSEA (Steiger & Lind, 1980), CFI (Bentler, 1990), and NNFI (Bollen, 1989) using the fit guidelines listed previously. After determining acceptable model fit, I interpreted the relationships between trait expectancies and changes in pain-related variables over time. Considering the final model was dependent upon Aim 1 CFA findings, the interpretation of this model was dependent upon the best-fitting factor structure of trait expectancies.

These analyses were first conducted using Sample 1 to examine the relationships between generalized expectancy and changes in pain-related outcomes in older adults with persistent pain over a 10-year period. Following this, these analyses were repeated using Sample 2 to examine changes in pain over a shorter, 2-year period. Then, significant regression paths in each of these models were examined to determine whether the impact of expectancies on pain trajectories over time differs based upon the time period examined. If paths between expectancy variables and changes in pain-related outcomes were generally consistent (i.e., the same paths were significant or non-significant), it was determined that the relative effect of expectancies on pain-related outcome trajectory is approximately consistent between a 2- and 10-year period. However, if these paths differed between the two samples, it was determined that the effect of expectancy on changes in pain over time varied between longer and shorter time periods.

Aim 3

To test Aim 3, I replicated Aim 2 mixed-latent and measured-variable path analysis but added control as a moderating variable for expectancy paths. That is, I examined whether the relationships between each expectancy variable and changes in each pain-related variable were moderated by the perception of control over health. To achieve this aim, the perception of control over health at Time 1 was modeled as an additional predictor variable for changes in pain-related outcomes over time. Additionally, interaction terms were modeled for each expectancy variable and the perception of control over heath. These interaction terms were also modeled to predict changes in pain over time. Any significant interaction terms indicated that the perception of control over health moderated the relationship between a given expectancy variable and changes in a given pain-related variable.

Once significant moderation relationships were identified within the path model, each identified significant moderation was re-run using the PROCESS macro in SPSS (Hayes, 2017). Therefore, significant moderators were first identified in path models and then re-run in PROCESS to further probe the relationship. Replicating significant moderators in both the path model and in PROCESS afforded benefits of reducing the chances of Type I error and ensuring consistent results to provide better interpretations of findings. To run these models, I regressed each Time 2 pain outcome onto its accompanying Time 1 pain outcome and saved the standardized, residualized change scores. The residualized change scores were used as the Y variables in PROCESS moderation models.

Power Analyses

Kline (2011) suggests that 1) a sample size of 300 is necessary to obtain adequate power to assess overall model fit and 2) a minimum of 10 participants per estimated parameter is necessary for sufficient power to estimate individual model parameters. Sample 1 had a 43:1

subject-to-parameter ratio and sample 2 had a 62:1 subject-to-parameter ratio in the most complex examined path model. For these reasons, the current analyses were sufficiently powered to assess model fit and estimate model parameters according to Kline's (2011) guidelines.

RESULTS

Data Cleaning and Preliminary Analyses

Sample 1: Examining Change over 10 Years

Approximately 34.4% (i.e., 5,931) of the HRS sample in 2008 indicated that they experienced persistent pain, with 65.4% indicating that they did not experience persistent pain and 0.1% reporting that they either did not know whether they had persistent pain or refusing to provide an answer to this question. Of the participants with persistent pain, 102 were under 50 years of age and were removed from the sample. The final sample size for Sample 1 was 5,829 participants. Approximately 46.5% of this sample completed the HRS study again a decade later in 2018. Descriptive statistics (e.g., means, standard deviations) and correlations were calculated for all measured variables (See Tables 1 & 2). Visually, data appeared relatively normal according to histograms. Data were also normal and linear according to Kline's (2011) guidelines.

Independent samples t-tests were conducted to examine the relationships between 1) attrition in 2018 and 2) demographic, expectancy, and pain variables in 2008. Results indicated that individuals who were retained in the dataset from 2008 to 2018 were significantly younger $t(5827) = 29.93$, $p < .001$, were more likely to be female $t(5827) = 3.05$, $p < .001$, were more likely to assess that they were in good health $t(5823) = 16.76$, $p < .001$, were less likely to have arthritis $t(5827) = 3.90$, $p < .001$, had higher BMIs $t(2486) = -5.38$, $p < .001$, were significantly more optimistic $t(2279) = 4.42$, $p < .001$, and were significantly less hopeless $t(2311) = 5.53$, $p < .001$. Pain variables in 2008 were also significantly associated with attrition such that individuals who completed both timepoints had significantly less disability $t(4727) = 15.31$, $p < .001$, less pain interference $t(5812) = 6.46$, $p < .001$, less pain severity $t(5807) = 7.04$, $p < .001$, and less depressive symptoms $t(5294) = 7.84$, $p < .001$ in 2008. Next, multiple regression analyses were conducted to examine whether attrition was related to pain-related outcomes in 2008 after controlling for identified auxiliary variables associated with attrition. Results indicated that pain variables were no longer significantly associated with attrition when

Table 1. Overall Study Characteristics of Included Studies

Variable		Sample 1- 2008	Sample 2- 2016
		Mean (SD)	Mean (SD)
Sample Size		5829	8314
Age		69.91 (10.31)	66.57 (11.34)
Optimism		13.07 (3.57)	13.19 (3.60)
Pessimism		8.45 (3.92)	12.53 (3.89)
Hopelessness		10.85 (5.32)	10.08 (5.38)
Disability		1.09 (1.63)	1.12 (1.63)
Depressive Symptoms		2.28 (2.31)	2.28 (2.30)
Percieved Control over Health		6.37 (2.69)	6.63 (2.57)
		Number (Valid %)	Number (Valid %)
Sex:	Male	2084 (35.8%)	3112 (37.4%)
Sexuality:	Straight		1497 (94.6%)
	Gay/Lesbian/Bisexual/Other		86 (5.4%)
Health Rating:	Excellent	143 (2.5%)	194 (2.3%)
	Very Good	907 (15.6%)	1336 (16.1%)
	Good	1840 (31.6%)	2732 (32.9%)
	Fair	1837 (31.5%)	2840 (34.2%)
	Poor	1098 (18.8%)	1202 (14.5%)
Military History:	Yes	1074 (18.6%)	965 (14.6%)
Pain Conditions:	Arthritis	4797 (82.4%)	6307 (76.0%)
	Osteoarthritis	3077 (52.8%)	3992 (48.0%)
	Rheumatoid Arthritis	920 (15.8%)	1531 (18.4%)
	Injury Related Arthritis	1313 (22.5%)	2084 (25.1%)
	Back Pain	3840 (66.0%)	5952 (71.8%)
BMI:	Underweight (< 18.50)	43 (1.7%)	73 (1.7%)
	Normal weight (18.50 – 24.99)	674 (23.8%)	883 (20.8%)
	Overweight (25.00 – 29.99)	798 (35.4%)	1373(32.3%)
	Obese (< or = 30.00)	973 (39.1%)	1921(45.2%)
MDD:	Yes	583 (10.0%)	1059 (12.7%)
Pain Medications:	Yes		6253 (75.4%)
Opiods:	Yes		2258 (28.1%)
Pain Interference:	Yes	3759 (64.5%)	5380 (65.3%)
Pain Severity:	Mild	1615 (27.8%)	2302 (27.9%)
	Moderate	3201 (55.1%)	4321 (52.3%)
	Severe	993 (17.1%)	1635 (19.8%)

Note. Sample 1- 2008 data are descriptive statistics calculated in Sample 1 from the 2008 timepoint. Sample 2- 2016 data are descriptive statistics calculated in Sample 2 from the 2016 timepont. SD = standard deviation, BMI = Body Mass Index, MDD = Major Depressive Disorder.

Table 2. Correlations of Study Variables

Sample 1- 10-year Longitudinal Sample Intercorrelations												
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. T1 Optimism	---											
2. T1 Pessimism	-.25**	---										
3. T1 Hopelessness	-.29**	.68**	---									
4. T1 Disability	-.10**	.12**	.19**	---								
5. T1 Interference	-.10**	.07**	.12**	.20**	---							
6. T1 Severity	-.07**	.10**	.13**	.17**	.32**	---						
7. T1 Depression	-.23**	.31**	.37**	.31**	.26**	.24**	---					
8. T1 Control	.20**	-.21**	-.31**	-.26**	-.17**	-.17**	-.27**	---				
9. T2 Disability	-.03	.05	.10**	.43**	.14**	.14**	.20**	-.10**	---			
10. T2 Interference	-.04	.09*	.09**	.20**	.28**	.18**	.17**	-.12**	.21**	---		
11. T2 Severity	-.03	.06	.06	.13**	.17**	.28**	.16**	-.11**	.18**	.30**	---	
12. T2 Depression	-.17**	.22**	.28**	.20**	.18**	.16**	.48**	-.14**	.31**	.24**	.23**	---
Sample 2- 2-year Longitudinal Sample Intercorrelations												
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. T1 Optimism	---											
2. T1 Pessimism	-.29**	---										
3. T1 Hopelessness	-.33**	.67**	---									
4. T1 Disability	-.03	.11**	.14**	---								
5. T1 Interference	-.07**	.15**	.15**	.21**	---							
6. T1 Severity	-.02	.11**	.10**	.20**	.36**	---						
7. T1 Depression	-.27**	.31**	.34**	.31**	.30**	.27**	---					
8. T1 Control	.23**	-.16**	-.24**	-.23**	-.21**	-.17**	-.27**	---				
9. T2 Disability	-.03	.09**	.15**	.64**	.18**	.17**	.24**	-.22**	---			
10. T2 Interference	-.04	.11*	.13**	.21**	.44**	.27**	.24**	-.19**	.22**	---		
11. T2 Severity	-.02	.07**	.06	.18**	.25**	.46**	.24**	-.14**	.19**	.35**	---	
12. T2 Depression	-.21**	.24**	.30**	.26**	.25**	.24**	.59**	-.24**	.29**	.26**	.27**	---

Note: Optimism is the sum of positively worded items on the LOT-R (items 2, 3, and 4). Pessimism is the sum of negatively worded items on the LOT-R (items 1, 5, and 6) and is reverse scored such that higher scores indicate greater pessimism. Correlations with pain interference are point-biserial correlations, as this item is dichotomous. All other correlations are Pearson's r. T1 = Time 1, T2= Time 2.

controlling for significant auxiliary demographic predictors. Considering this, missingness due to attrition was MAR and FIML estimation method was used to account for missing data in path analyses as suggested by Muthén and Muthén (2017b).

Sample 2: Examining Change over 2 Years

Approximately 41.1% (i.e., 8,596) of the HRS sample in 2016 indicated that they experienced persistent pain, with an additional 58.5% indicating that they did not experience persistent pain and 0.4% reporting that they either did not know whether they had persistent pain or refusing to provide an answer to this question. Of the participants with persistent pain, 282 were under 50 years of age and were removed from the sample. The final sample size for Sample 2 was 8,314 participants. Approximately 79.3% of this sample completed the HRS study again two years later in 2018. Descriptive statistics and correlations were calculated for all measured variables (see Tables 1 & 2). Like Sample 1, data appeared normal according to histograms and were statistically normal and linear according to Kline's (2011) guidelines.

Independent samples t-tests were conducted to examine the relationships between attrition in 2018 and demographic, expectancy, and pain variables in 2016. Again, several of these variables were identified as contributing to attrition. Individuals who completed the survey at both timepoints were significantly younger $t(8312) = 11.08$, $p < .001$, more likely to assess that they were in good health $t(8302) = 9.19$, $p < .001$, significantly more optimistic $t(2336) = 2.59$, $p = .010$, and significantly less hopeless $t(2413) = 3.56$, $p < .001$. Pain variables were also significantly associated with attrition such that individuals who completed both timepoints had significantly less disability $t(6309) = 11.16$, $p < .001$, less pain interference $t(8233) = 3.99$, $p < .001$, less pain severity $t(8256) = 2.93$, $p = .003$, and less depressive symptoms $t(7761) = 5.376$, $p < .001$ in 2016. Multiple regression analyses indicated that pain variables were no longer significantly associated with attrition when controlling for significant auxiliary demographic predictors. Accordingly, like Sample 1, missingness due to attrition was MAR and FIML estimation method was used to account for missing data in path analyses (Muthén & Muthén, 2017b).

Aim 1

Aim 1 was to determine the structure of optimism and hopelessness as measured in the current study. First, three competing a priori models were tested (see Table 3 and Figure 1). None of these models demonstrated good fit across indices. Thus, modification indices were examined. None of the suggested modification indices significantly improved the overall model fit or aligned with a theoretical understanding of these constructs. Next, individual factor loadings within a priori models were examined. Across the three models, all indicators but one (i.e., LOT-R item two in Model 1) had factor loadings at or above .3, which is the minimum level of association necessary to interpret the factor structure (Hair, Black, Babin, Anderson, & Tatham, 2006). However, across all three models, LOT-R items two, three, and four were the only indicators to have factor loadings less than .5, which is the minimal threshold for practical significance (Hair et al., 2006). Upon further examination, it was found that these three items were the only positively worded expectancy items within this model (e.g., “I expect the best in uncertain times”). Previous CFAs of the LOT-R have found that positively worded items may measure optimism, and negatively worded items may measure pessimism (Chang, D'Zurilla, & Maydeu-Olivares, 1994). However, across studies, there is little consensus as to whether the LOT-R is best modeled as a unifactor concept (i.e., optimism) or as a correlated factors concept (i.e., optimism and pessimism being distinct, but related concepts).

Given that 1) a piori CFA models did not show good fit to the data, 2) the positively worded items loaded in a different pattern than negatively worded items, and 3) previous work suggests the LOT-R can be split into two separate constructs, three additional a posteriori models were created and tested (See Figure 2). First, Model 4 was a correlated, two-factor model of “positive expectancy” and “negative expectancy”. In this model, all items measuring negative expectations for the future (i.e., LOT-R items 1, 5, and 6 and all hopelessness items) loaded onto a factor labeled “negative expectancy” and all items measuring positive expectations for the future (i.e., LOT-R items 2, 3, and 4) loaded onto a factor labeled “positive expectancy”. These two factors were freed to correlate. Second, Model 5 was a three-factor model. In this model, “optimism” included the three positively worded LOT-R items, “pessimism” included the three negatively worded LOT-R items, and hopelessness included the four hopelessness items. Optimism, pessimism, and hopelessness were freed to correlate. Lastly, Model 6 was a hierarchical model of positive and negative expectancies. Building off of Model 5, optimism,

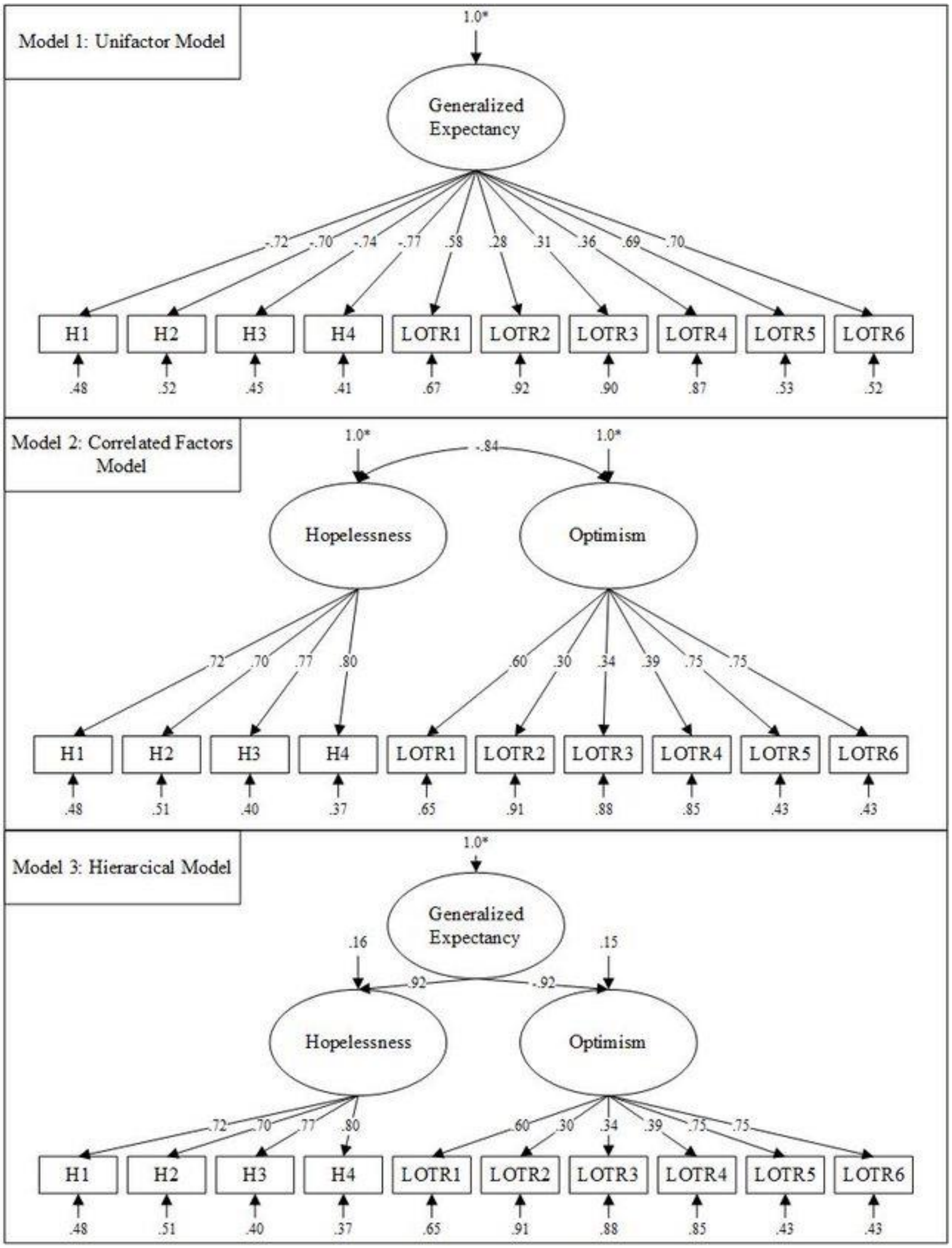

Figure 1. A Priori CFA Model Results

Note: H = Hopelessness Scale items; LOTR = Life Orientation Test- Revised items

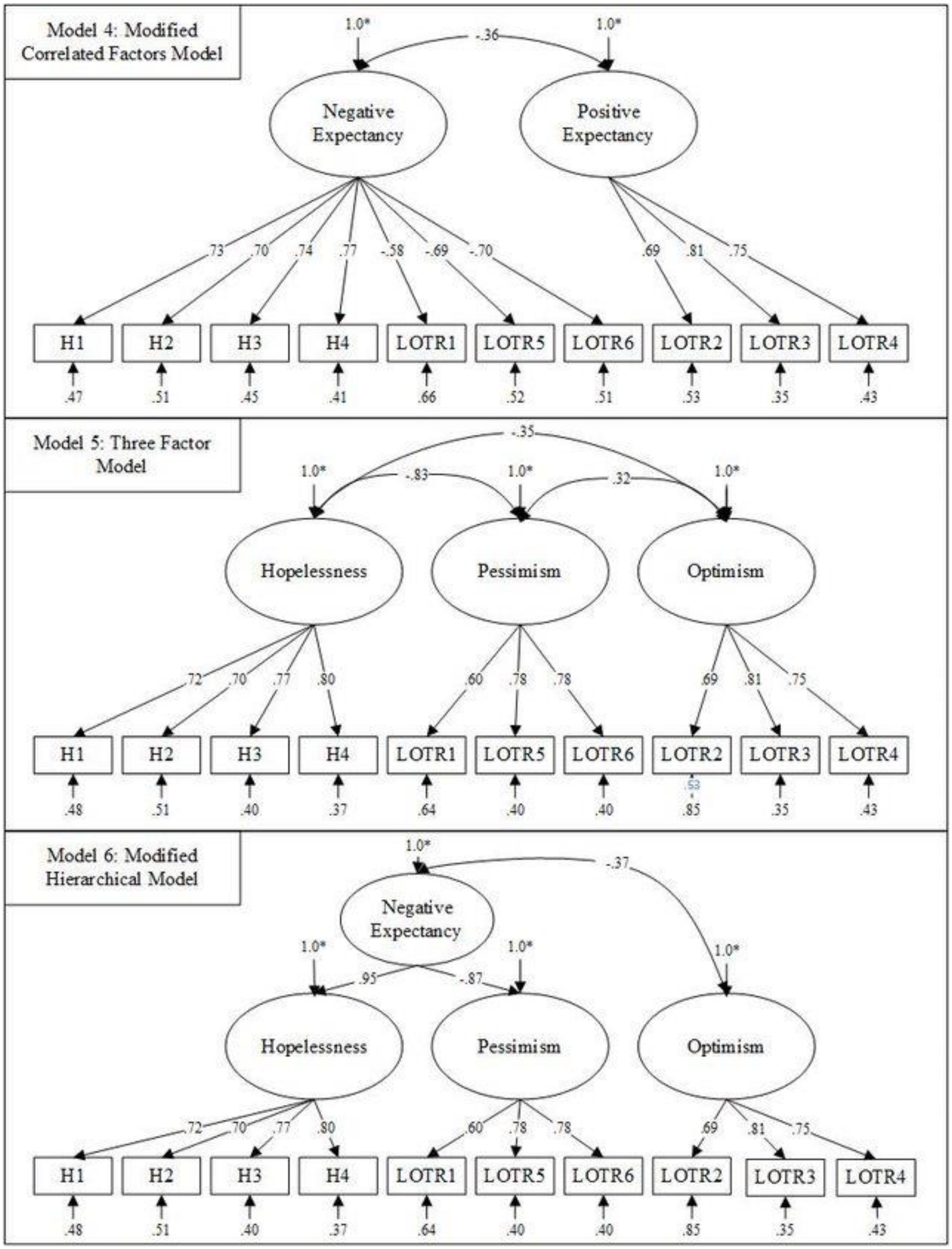

Figure 2. A Posteriori CFA Model Results

Note: H = Hopelessness Scale items; LOTR = Life Orientation Test- Revised items

Table 3. CFA Fit Indices using MLR

Model	Data Collection Year	χ2	df	p	SRMR (≤0.08)	RMSEA (≤0.06)	RMSEA 90% CI	CFI (≥0.95)	NNFI (>0.95)	AIC (Lowest)
A Priori Models (Sample 1; N = 2402)										
1	2008	1664.45	35	<0.001	0.11	0.14	0.13-0.15	0.74	0.66	80882.68
2	2008	1526.98	34	<0.001	0.10	0.14	0.13-0.14	0.76	0.68	80622.00
3	2008	1482.01	33	<0.001	0.10	0.14	0.13-0.14	0.77	0.68	80624.00
A Posteriori Models (Sample 1; N = 2402)										
Model	Year	χ2	df	p	SRMR (≤0.08)	RMSEA (≤0.06)	RMSEA 90% CI	CFI (≥0.95)	NNFI (>0.95)	AIC (Lowest)
4	2008	424.76	34	<0.001	**0.04**	0.07	0.06-0.08	0.94	0.92	79089.26
5	2008	235.90	32	<0.001	**0.03**	**0.05**	**0.05-0.06**	**0.97**	**0.95**	**78828.90**
6	2008	235.90	32	<0.001	**0.03**	**0.05**	**0.05-0.06**	**0.97**	**0.95**	**78828.90**
Replicating best fitting model (Sample 2; N = 1116 for 2016, N = 998 for 2018)										
Model	Year	χ2	df	p	SRMR (≤0.08)	RMSEA (≤0.06)	RMSEA 90% CI	CFI (≥0.95)	NNFI (>0.95)	AIC (Lowest)
6	2016	84.30	32	<.001	**0.03**	**0.04**	**0.03-0.05**	**0.98**	**0.98**	35115.80
6	2018	143.87	32	<.0001	**0.04**	**0.06**	**0.05-0.07**	**0.96**	**0.94**	31162.54

Note: Bold results indicate "good fit"; χ2 = chi-square, df = degrees of freedom, CFA = Confirmatory Factor Analysis, MLR = maximum likelihood estimation method with robust standard errors, SRMR = Standardized Root Mean Square Residual, RMSEA = Root Mean Square Error of Approximation, CI = Confidence Interval, CFI = Confirmatory Fit Index, NNFI = Non-Normed Fit Index, AIC = Akaike Information Criterion pessimism, and hopelessness were first-order latent variables. However, in this model, there was also a second-order latent variable coined “negative expectancy” that consisted of the latent constructs of pessimism and hopelessness.

All three a posteriori models demonstrated significantly better fit than a priori models across all fit indices (see Table 3 and Figure 2). Models 5 and 6 demonstrated identical fit across all fit indices except for the chi-square index. However, the correlation between hopelessness and pessimism in Model 5 was large (i.e., -.83). Considering that the purpose of this CFA was to determine the most appropriate factor structure for subsequent path analyses, the high correlation between these factors was a concern. As the best fitting model would be used in path regression, the high correlation between these two factors could contribute to multicollinearity and, in turn, misleading results. Thus, Model 6 was chosen as the best fitting model due to its performance across fit indices and its reduction of multicollinearity concerns. Moreover, choosing this model provided the opportunity to examine the unique effects of positive and negative expectancies on changes in pain-related outcomes over time. To ensure that this conceptualization was appropriate, Model 6 was replicated with data from 2016 and 2018 (see Table 3) and demonstrated consistently good fit across indices.

Aim 2

Aim 2 was to examine how the shared and unique aspects of optimism and hopelessness differentially predicted changes in pain for older adults experiencing clinical pain over time. Considering findings in Aim 1, Aim 2 was changed to examine how the shared and unique aspects of optimism and *negative expectancy* predicted changes over time. Therefore, this analysis essentially tested a competing model of whether positive or negative generalized expectancies predict changes in pain over time. I created two separate models to examine changes in pain variables over a 10-year and a 2-year period.

Sample 1: Expectancy predicting changes in pain over 10 years

First, I aimed to identify significant covariates (i.e., age and sex) that might explain changes in pain variables over time that were not related to expectancy. I created a mixed latent and measured variable path analysis with hypothesized covariates at Time 1 (2008) predicting disability, pain interference, pain severity, and depressive symptoms at Time 2 (2018) while controlling for previous levels of each outcome at Time 1. All pain variables at Time 1 were freed to correlate, all pain variables at Time 2 were freed to correlate, and residual terms for identical indicators were correlated across time. This model allowed for the identification of significant covariates that predict a change in each individual pain outcome of interest. In this model, sex significantly predicted 10-year changes in pain severity ($\beta = -.06$, $p = .009$), pain interference ($\beta = -.08$, $p < .001$), and depressive symptoms ($\beta = -.05$, $p = .016$) such that females had additional worsening of pain interference, pain severity, and depressive symptoms over a 10-year period as compared to men. Age significantly predicted changes in disability ($\beta = .29$, $p < .001$) and depressive symptoms ($\beta = .13$, $p < .001$) but not pain severity or interference. Older individuals had worsening disability and greater increases in depressive symptoms over time as compared to younger individuals. Considering these findings, age was modeled as a predictor of disability and depressive symptoms while sex was modeled as a predictor of pain severity, pain interference, and depressive symptoms in the final model.

Next, I modeled optimism and negative expectancy at Time 1 (2008) to predict pain severity, pain interference, disability, and depressive symptoms at Time 2 (2018) while controlling for previous levels of each outcome and identified covariates. This model was examined using MLR estimation method with FIML to account for missing data. The model achieved good fit according to SRMR (0.04) and RMSEA (0.03, 90% CI= .03 - .03) and acceptable fit according to CFI (0.91) and NNFI (0.90). Chi-square was significant (χ^2 = 4439.55, $p < .001$). However, chi-square is sensitive to sample size and commonly rejects goodness-of-fit in models with very large samples. Assessing for model fit across these indices, the model appeared to show acceptable fit to the data. To further improve model fit, modification indices were examined. However, none of the suggested modification indices significantly improved the model, were in line with theoretical rationale, and were consistent with the longitudinal nature of the data (e.g., suggestion to model pain interference in 2018 as a predictor or disability in 2008). Due to the model meeting standards for fit, model paths were examined (see Figure 3 and Table 4).

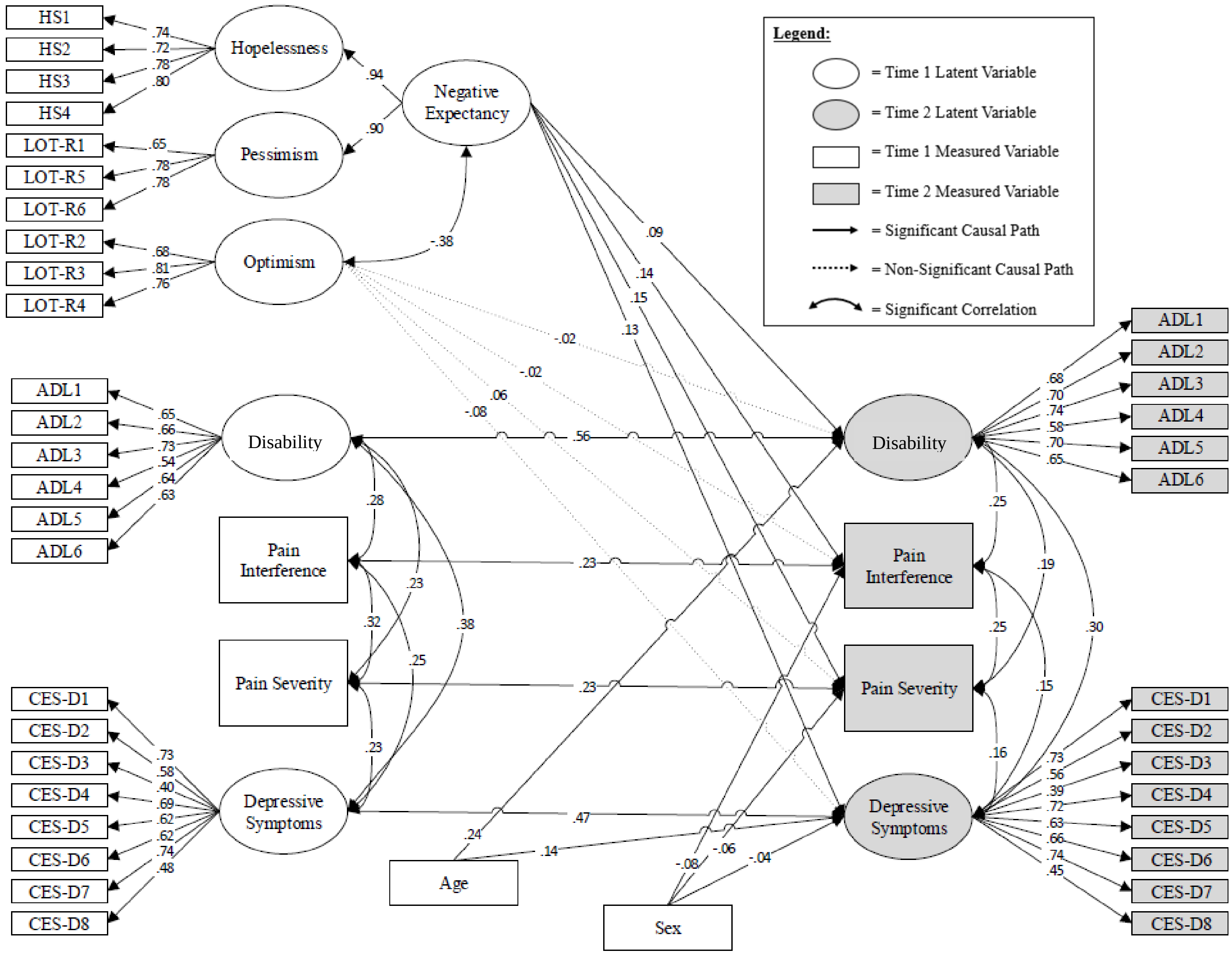

Figure 3. Expectancy Predicting Changes in Pain over 10 Years

Note: HS = Hopelessness Scale, LOT-R = Life Orientation Test- Revised, ADL = Activities of Daily Living Scale, CES-D = eight item Center for Epidemiologic Studies – Depression Scale

Table 4. Aim 2: Change over 10-Years Path Analysis Intercorrelations

Time 1 Path Analysis Intercorrelations						
Variable	1.	2.	3.	4.	5.	6.
1. NE	---					
2. Optimism	-.38**	---				
3. Disability	.27**	-.15**	---			
4. Interference	.15**	-.13**	.28**	---		
5. Severity	.14**	-.08**	.23**	.32**	---	
6. Depression	.48**	-.28**	.39**	.25**	.23**	---
7. Sex	.02	-.02	-.04**	-.09**	-.10**	-.09**
8. Age	.03	.05*	.27**	.00	.03*	-.02

Time 2 Path Analysis Intercorrelations			
Variable	1.	2.	3.
1. Disability	---		
2. Interference	.25**	---	
3. Severity	.19**	.25**	---
4. Depression	.30**	.15**	.16**

Note. * = p > .05, ** = p > .001, NE = Negative Expectancy

Contrary to expectations, optimism did not significantly predict changes in pain severity, pain interference, disability, or depressive symptoms in older adults with pain. However, negative expectancy significantly predicted changes in all four pain-related outcomes. Greater negative expectations in 2008 predicted a greater incline in pain severity, pain interference, disability, and depressive symptoms in 2018 while controlling for previous levels of each of these outcomes and identified covariates. Thus, when examined concurrently, it appears that only negative, not positive, expectations significantly predict changes (i.e., worsening) in pain-related outcomes over a 10-year period for older adults with persistent pain.

Sample 2: Expectancy predicting changes in pain over 2 years

The exact model used in Sample 1 to identify covariates was reproduced in Sample 2. In this model, sex significantly predicted 2-year changes in pain severity ($\beta = -.04$, $p = .001$), pain interference ($\beta = -.05$, $p < .001$), and depressive symptoms ($\beta = -.04$, $p < .001$) such that females had additional worsening of pain severity, pain interference, and depressive symptoms over a 2-year period as compared to men. Age significantly predicted changes in pain severity ($\beta = -.04$, $p = .008$), pain interference ($\beta = -.04$, $p = .011$), and disability ($\beta = .14$, $p < .001$). Older individuals had steeper increases in disability but less increases in pain severity and interference over time as compared to younger individuals. Considering these findings, age was modeled as a predictor of pain severity, pain interference, and disability while sex was modeled as a predictor of pain severity, pain interference, and depressive symptoms in the final model.

I modeled optimism and negative expectancy at Time 1 (2016) to predict pain severity, pain interference, disability, and depressive symptoms at Time 2 (2018) while controlling for previous levels of each outcome and identified covariates. Again, MLR estimation method with FIML was used to account for missing data. The model achieved good fit according to SRMR (0.05) and RMSEA (0.03, 90% CI= .03 - .03) and poor fit according to CFI (0.88) and NNFI (0.86). CFI and NNFI calculations are both dependent upon the average size of correlations in the covariance matrix, thus their consistency in findings was unsurprising (Kenny, 2015). Like the 10-year model, chi-square was significant ($\chi^2 = 8917.97$, $p < .001$) which was likely due to the large sample size. Modification indices were examined but none significantly improved the model fit, were in line with theoretical rationale, and were consistent with the longitudinal nature of the data. Overall, the model demonstrated inconsistent fit to the data across the measured fit indices. However, in line with suggestions by Lai and Green (2016), the model was retained despite discrepancies in fit, as disagreements between fit indices are unlikely to be diagnostic of fit problems, but rather are indicative of indices which evaluate fit from different perspectives (e.g., non-centrality based fit indices, relative fit indices, absolute fit indices, etc.).

Next, model paths were examined (See Figure 4 and Table 5). This model replicated the patterns found in the previous 10-year model. That is, negative expectancy, but not optimism, significantly predicted changes in pain severity, pain interference, disability, and depressive symptoms in older adults with pain across a 2-year span. Greater negative expectations in 2016 predicted a greater incline in pain severity, pain interference, disability, and depressive symptoms in 2018 while controlling for previous levels of each of these outcomes and identified covariates. Thus, when examined concurrently, only negative, not positive, expectations significantly contributed to changes in pain-related outcomes over a 2-year period for older adults with persistent pain. The consistency in negative expectancies predicting worse pain trajectories at both 10 and 2 years suggests that the relative effect of negative generalized expectancies on pain trajectory is approximately consistent between a 2- and 10-year period.

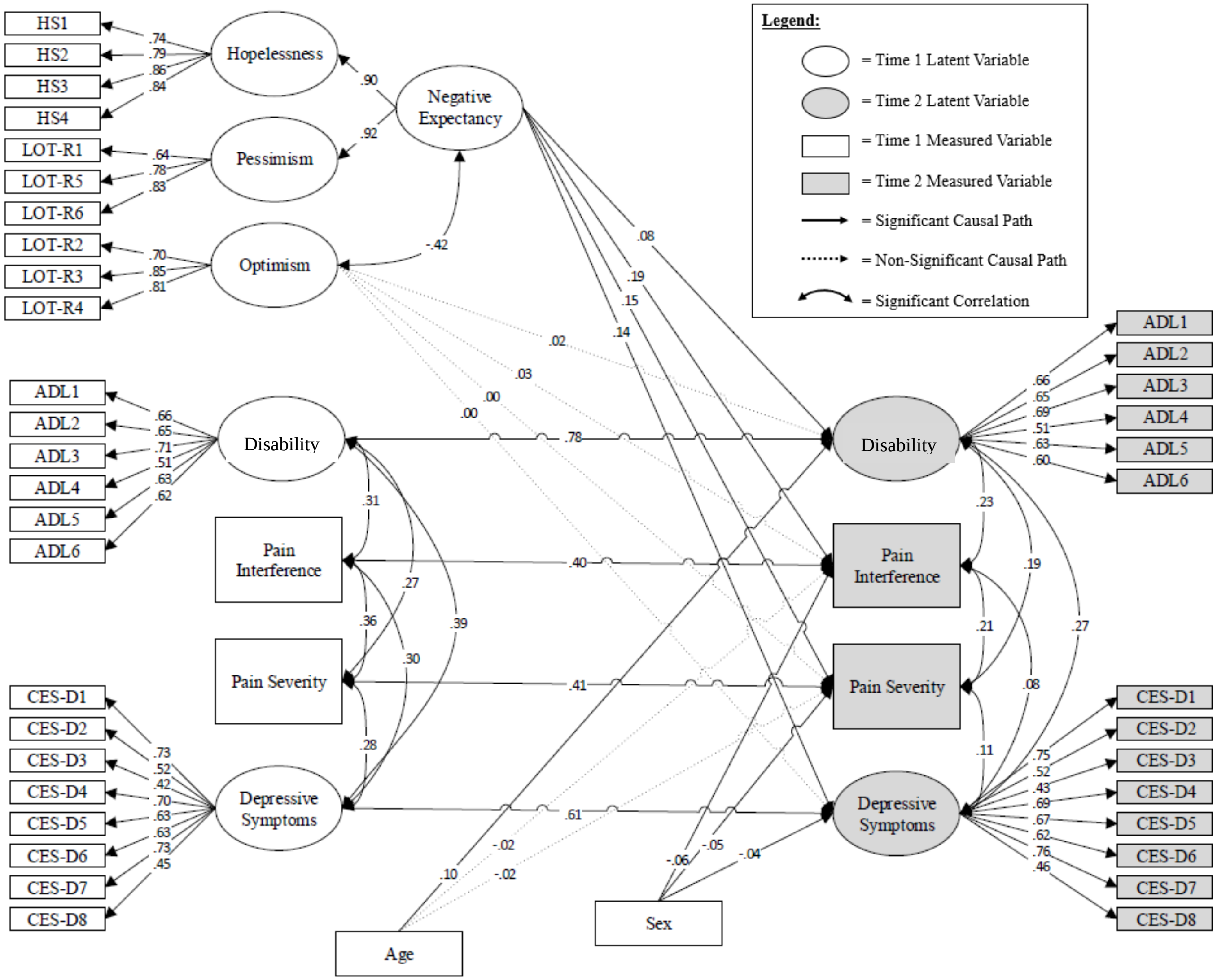

Figure 4. Expectancy Predicting Changes in Pain over 2 Years

Note: HS = Hopelessness Scale, LOT-R = Life Orientation Test- Revised, ADL = Activities of Daily Living Scale, CES-D = eight item Center for Epidemiologic Studies – Depression Scale

Table 5. Aim 2: Change over 2-Years Path Analysis Intercorrelations

Time 1 Path Analysis Intercorrelations						
Variable	1.	2.	3.	4.	5.	6.
1. NE	---					
2. Optimism	-.42**	---				
3. Disability	.28**	-.07*	---			
4. Interference	.22**	-.09**	.31**	---		
5. Severity	.18**	-.04	.27**	.36**	---	
6. Depression	.48**	-.34**	.39**	.30**	.28**	---
7. Sex	.03	-.07*	-.04*	-.07**	-.09**	-.10**
8. Age	-.06*	.06*	.17**	.04**	-.04*	-.07**

Time 2 Path Analysis Intercorrelations			
Variable	1.	2.	3.
1. Disability	---		
2. Interference	.23**	---	
3. Severity	.19**	.21**	---
4. Depression	.27**	.08**	.11**

Note. * = p > .05, ** = p > .001, NE = Negative Expectancy

Aim 3

Aim 3 was to examine whether the relationships between trait expectancies and changes in pain-related outcomes were moderated by perceptions of control over one's health. To achieve this aim, mixed latent and measured variable path analysis model for Aim 2 was replicated. However, participant's perception of control over their health was added as a moderating variable for both the negative expectancy latent variable and the optimism latent variable's relationships with pain-related outcomes.

Sample 1

This model was first run in Sample 1. The model was unable to converge in Mplus due to large variances for interaction terms. To correct for this, the interaction terms were rescaled by dividing each computed interaction by a large number (i.e., 100) as is suggested (Muthén & Muthén, 2017b). Because this initial model was conducted only to identify potential moderators for further examination using PROCESS, the rescaling would not impact interpretations of significant moderators. With the rescaled interaction terms, this model achieved acceptable fit (χ^2

= 4615.63, $p < .001$, SRMR = 0.04, RMSEA 0.03, RMSEA 90% CI = .03 - .03, CFI = 0.92, NNFI = 0.91). Results of this model demonstrated that perceived control did not significantly moderate the relationships between negative expectancies and any pain-related outcome. However, the interaction terms for the perception of control moderating the relationships between optimism and 1) disability ($\beta = -1.72$, $p = .007$), 2) pain interference ($\beta = 1.3$, $p = .002$), and 3) pain severity ($\beta = 1.90$, $p = .001$) were significant.

To replicate and further probe these moderating effects, each significant moderator was examined a second time using the PROCESS macro in SPSS. First, the perception of control moderating the relationship between optimism and changes in disability were examined. Within this model, the interaction between optimism and the perception of control over health trended toward significance ($b = -.008$, $t(667) = -1.96$, $p =.051$; See Figure 5 for graph). For individuals who perceived average to high levels of control over their health (i.e., > 6/10), greater optimism was associated with less disability over a 10-year period. However, when individuals perceived low levels of control over their health, greater optimism was associated with greater disability over a 10-year period. Second, I examined the perception of control moderating the relationship between optimism and changes in pain interference over time. This finding did not replicate using PROCESS as the interaction term was insignificant ($b = -.002$ $t(776) = -.55$, $p =.582$). Third, I examined the perception of control as moderating the relationship between optimism and changes in pain severity over time. The interaction term was significant ($b = -.008$, $t(772) = -2.19$, $p =.029$; See Figure 6 for graph). For those with high levels of control over their health, any level of optimism was associated with reductions in pain severity over time. However, for those with medium to low levels of control, greater optimism was associated with worse pain severity over time.

Sample 2

Procedures were run again in Sample 2 to assess for consistency in moderation. This model was constructed identically to moderation analyses in Sample 1, with rescaled interaction terms. The model achieved acceptable fit (SRMR = 0.04, RMSEA 0.03, RMSEA 90% CI = .03 - .03, CFI = 0.89, NNFI = 0.87, $\chi^2 = 9086.61$, $p < .001$). Results demonstrated that perceived control significantly moderated the relationships between 1) negative expectancies and pain severity (β =

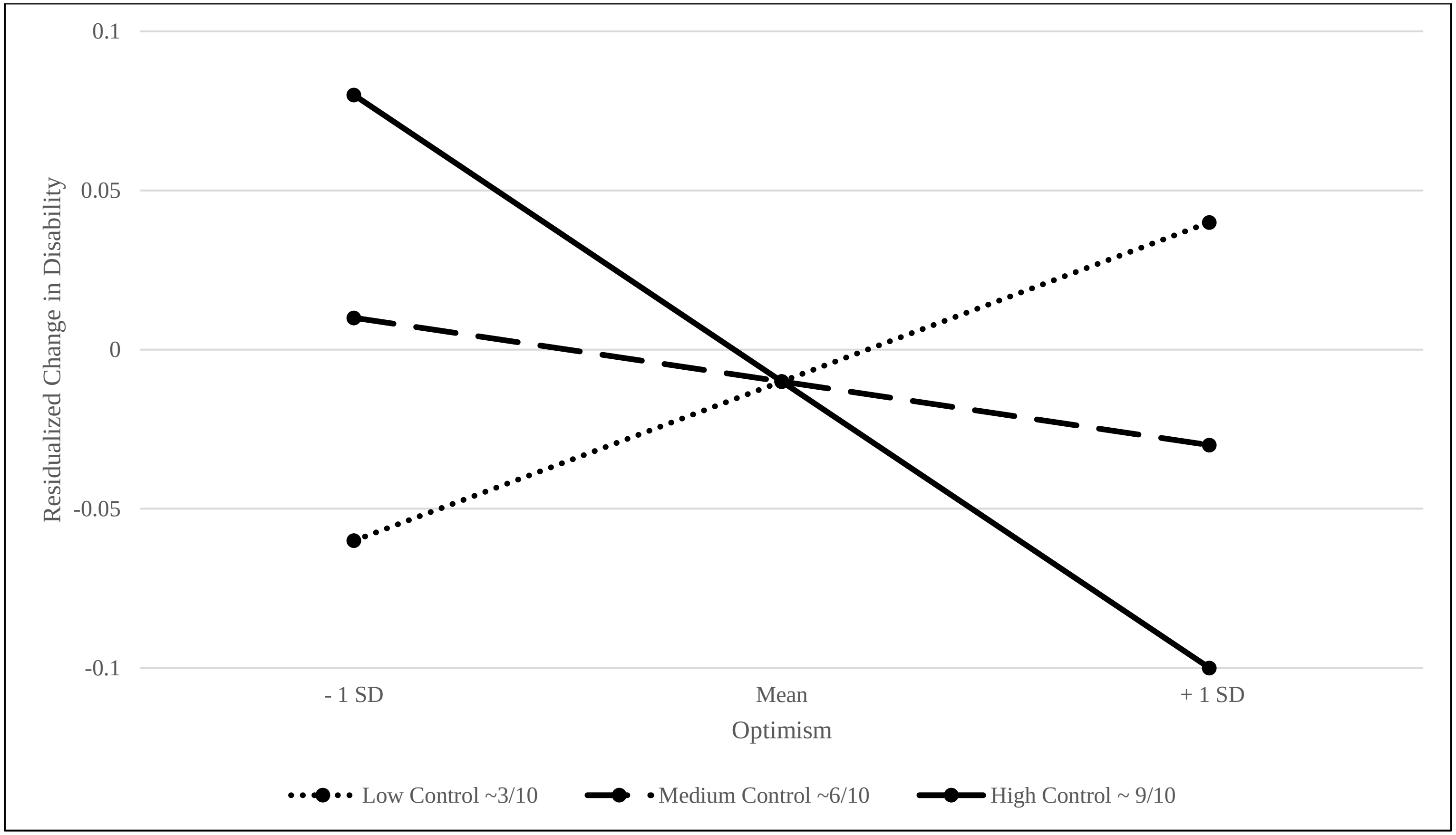

Figure 5. Perceived Control over Health Moderates the Relationship between Optimism and 10-year changes in Disability

Note: For individuals who perceived average to high levels of control over their health (i.e., > 6/10), greater optimism was associated with reductions in disability over a 10-year period. However, for individuals who perceived low levels of control over their health, greater optimism was associated with worsening disability over a 10-year period.

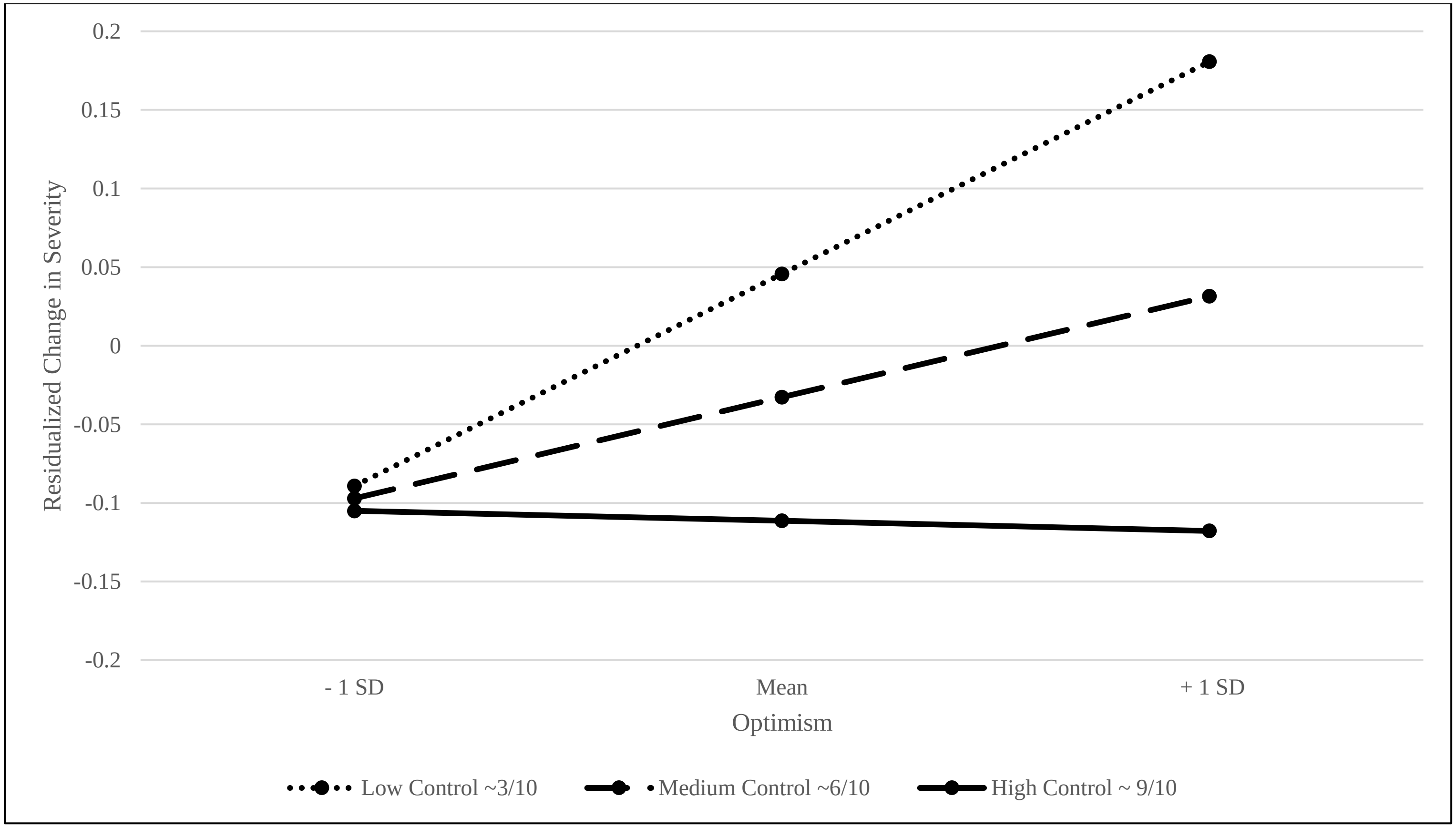

Figure 6. Perceived Control over Health Moderates the Relationship between Optimism and 10-year changes in Severity

Note: For those with high levels of perceived control over their health any level of optimism was associated with reductions in pain severity over time. However, for those who perceived medium to low levels of control, greater optimism was associated with worsening pain severity over time.

-2.22, $p = .049$) and 2) optimism and depression ($\beta = 2.81$, $p = .03$). This was inconsistent with Sample 1 moderation findings. These significant moderators were examined a second time using the PROCESS macro in SPSS to ensure replication and to better understand the nature of the interactions. However, neither the analysis examining perception of control as a moderator of the relationship between negative expectancy and pain severity ($b = .00$, $t(1452) = 1.12$, $p = .26$) nor optimism and depression ($b = -.00$, $t(1883) = -1.4$, $p = .16$) replicated.

Post-hoc Analyses

Moderation analyses demonstrated inconsistent results with difficulties replicating, even using the same data set. This raises concerns about the reliability and importance of findings. Unfortunately, the original Aim 3 hypotheses were dependent upon Aim 1 findings. That is, the theoretical groundwork and framing of this hypothesis was dependent upon finding a factor structure which suggested optimism and hopelessness as measured in the current sample were distinct, but related variables. However, as is seen in Aim 1, these hypotheses were unsupported by the data. These constructs were best modeled with a hierarchical factor structure (i.e., positively worded LOT-R items representing optimism, negatively worded LOT-R items representing pessimism, and hopelessness items representing hopelessness, with pessimism and hopelessness representing first-order factors of a second-order construct coined negative expectancies). Thus, the original hypotheses attempting to differentiate between optimism and hopelessness were no longer relevant, leading to an unsatisfactory (and not theoretically grounded) research question.

However, the perception of control in general, and the perception of control over one's health specifically, has previously been associated with both health and pain symptoms (Campbell, Hope, & Dunn, 2017; Hong et al., 2021; Wong & Anitescu, 2017). Therefore, a post hoc analysis was run to examine whether the perception of control over one's health uniquely and significantly predicted changes in pain-related outcomes above and beyond generalized expectancies. To test this post-hoc question, I ran a model identical to the models examined in Aim 2, but with the addition of the perception of control as a predictor variable for all pain variables. This model was statistically limited in that previous models identified few moderation relationships. However, these moderators were unreliable, with several identified moderators being unable to replicate even within the same dataset. Nonetheless, the following analyses should be interpreted with caution.

In Sample 1, this model achieved acceptable fit overall (SRMR = 0.04, RMSEA = .03, RMSEA 90% CI= .03 - .03, CFI = 0.91, NNFI = .90, $\chi^2 = 4475.35$, $p < .001$). Mirroring results in Aim 2, negative expectancy was significantly associated with overall worsening pain trajectories; whereas, optimism was not significantly associated with changes in pain-related outcomes over time (pain severity: $\beta = -.07$, $p = .116$; pain interference: $\beta = -.01$, $p = .852$; disability: $\beta = -.01$, $p = .820$; depressive symptoms: $\beta = -.07$, $p = .064$). Greater negative expectancies in 2008 were associated worsening pain severity ($\beta = .12$, $p = .015$), pain interference ($\beta = .10$, $p = .022$), disability ($\beta = .08$, $p = .037$), and depressive symptoms ($\beta = .12$, $p = .008$) across 10 years. However, one's perception of control over their health in 2008 also predicted the trajectory of some pain-related outcomes a decade later. Specifically, perceiving that one had greater control over their health was significantly associated with less pain severity ($\beta = -.10$, $p = .015$) and interference ($\beta = -.11$, $p = .002$). The perception of control was not significantly associated with changes in disability ($\beta = -.03$, $p = .433$) or depressive symptoms ($\beta = -.03$, $p = .297$) over time.

In Sample 2, this model achieved fair fit (SRMR = 0.04, RMSEA = .03, RMSEA 90% CI= .03 - .03, CFI = 0.88, NNFI = .86, $\chi^2 = 9838.79$, $p < .001$). Optimism was not significantly associated with pain-related outcomes (pain severity: $\beta = -.01$, $p = .681$; pain interference: $\beta = -.05$, $p = .099$; disability: $\beta = -.03$, $p = .303$; depressive symptoms: $\beta = -.01$, $p = .629$).Negative expectancies in 2016 were associated with 2-year changes in pain severity ($\beta = .11$, $p < .001$), pain interference ($\beta = .13$, $p < .001$), and depressive symptoms ($\beta = .11$, $p < .001$), but not disability ($\beta = .06$, $p = .068$). Finally, the perception of control over one's health significantly predicted convalescing pain severity ($\beta = -.11$, $p < .001$), pain interference ($\beta = -.15$, $p < .001$), disability ($\beta = -.07$, $p = .010$), and depressive symptoms ($\beta = .09$, $p < .001$). Taken together, these findings suggest that the perception of control over one's health is significantly associated with changes in pain, even when controlling for generalized expectancies. However, these specific perceptions of control appeared to be more robust proximal predictors of changes in pain-outcomes over time. That is, health-related perceived control was associated with more pain-related outcomes at 2 years than at 10 years.

DISCUSSION

The overarching goal of the current study was to examine the associations between trait expectancies and changes in pain-related outcomes over time in older adults with persistent pain. Results, in their broadest sense, suggest that older adults with higher levels of negative expectancies experienced greater increases in pain severity, pain interference, disability, and depressive symptoms over time. The current results expanded upon previous research in five main ways.

First, previous research suggests that trait expectancies, like optimism and hopelessness, are similar, but distinct concepts (Rand, 2009; Fowler et al., 2017). Therefore, this study initially aimed to examine the unique predictive utility of optimism and hopelessness on changes in pain-related outcomes over time. However, the current results suggested that these expectancies were best understood in terms of their valence (i.e., a positive or negative expectation). Thus, this aim was changed to examine the differential predictive utility of positive (i.e., optimism) versus negative (i.e., pessimism and hopelessness) expectancies on changes in pain-related outcomes. Counter to my hypothesis, only negative expectancies were predictive of changes in pain-related outcomes over time.

Second, to build support for the theory that trait expectancies change the way in which individuals' function with pain, this study aimed to examine whether trait expectancies predicted changes in pain over time. As hypothesized, I found that trait expectancies were associated with the rate by which pain-related outcomes changed over time in older adults with persistent pain. Negative trait expectancies were associated with poorer pain trajectories in those experiencing persistent pain. Specifically, greater negative expectancies were associated with worsening pain severity, pain interference, disability, and depressive symptoms over time.

Third, the literature to date suggests that pain trajectories may change over time (Costa et al., 2012); however, it is unknown what factors contribute to these differences in the rate of change. For this reason, I examined whether the relationships between trait expectancies and changes pain were consistent across a 2- and 10-year period. I found that trait expectancies appear to have consistent, significant associations with changes in pain across 2-year and 10-year periods.

Fourth, the current study provided evidence of the broad impact of negative expectancies on the overall pain experience in older adults with persistent pain. Negative expectances were related to changes in both mental and physical health in several domains, suggesting that the impact of negative expectancies may be particularly wide-reaching.

Fifth, previous studies have demonstrated that the perception of control may change the impact of certain expectancies (Shanahan et al., 2020). Thus, the current study aimed to examine the associations between the perception of control over one's health and changes in pain. The perception of control over one's health independently predicted some changes in pain over time, even when controlling for trait expectancies. The following discussion will review these extensions of our current knowledge in greater detail, discuss the potential mechanisms driving these relationships through a theoretical lens, and identify the implications of this work.

(Negative) Expectancies Predict Changes in Pain

Only negative expectancies predicted changes in pain-related outcomes over time in a sample of older adults with persistent pain. This finding is discrepant from several studies suggesting that positive expectancies, such as optimism, hope, and self-efficacy, are associated with pain-related outcomes (Garofalo, 2000; Goodin & Bulls, 2013; Jackson et al., 2014; Shanahan et al., 2021). To better understand this finding, I first discuss the conceptualization of expectancies in older adults.

Understanding expectancies in older adults with persistent pain

Contrary to hypotheses, the current results suggest that hopelessness and optimism are best conceptualized as generalized positive (i.e., optimism) and negative (i.e., pessimism and hopelessness) expectancies in older adults with persistent pain. This supports the notion that believing in a positive future is not the antithesis of believing in a negative one. Previous research has demonstrated that positive and negative expectations are not unidimensional concepts (Huen, Ip, Ho, & Yip, 2015). Similarly, other seemingly antithetical psychological concepts are widely considered distinct phenomena, such as positive and negative affect (Diener & Emmons, 1984; Watson, Clark, & Tellegen, 1988), sadness and happiness (Ekman, 1992), and distress and well-being (Massé et al., 1998; Veit & Ware, 1983). Thus, while these results were not hypothesized, they are not without precedent. The current findings suggest that research examining expectancies in older adults should distinguish between a belief in a positive or negative future.

Whether optimism and pessimism should be considered separate phenomena has been of recent debate within the academic literature (Scheier, Swanson et al., 2021; Scheier et al., in press; VanderWeele & Kubzansky, 2021). However, research appears to primarily support the idea that optimism and pessimism are related, but separate, phenomena. For example, a meta-analysis of over 56 studies found that optimism and pessimism only correlate at about -.56 (Alarcon, Bowling, & Khazon, 2013). Additionally, several studies have found that optimism and pessimism differentially predict various outcomes, including psychological distress, psychological well-being, coping, career-related goal setting and decision making, and school achievement (Chang & Sanna, 2001; Creed, Patton, & Bartrum, 2002; Nes & Segerstrom, 2006). Moreover, a recent meta-analysis found that pessimism had more robust associations with health outcomes compared to optimism, mirroring the results in the current study (Scheier et al., 2020). Finally, genetics research has shown differences in genetic and environmental predispositions for optimism and pessimism (Bates, 2015; Mosing, Zietsch, Shekar, Wright, & Martin, 2009; Plomin et al., 1992).

The current findings should also be interpreted considering the study sample (i.e., adults over 50 years of age with persistent pain). There is evidence that as individuals age, both optimism and pessimism increase, rather than one increasing while the other decreases (Herzberg et al., 2006). Moreover, previous CFAs have found the correlation between pessimism and optimism continuously changes with age from moderate negative correlations in young adults to small negative or even small positive correlations in adults over 60 years of age (Herzberg et al., 2006). In line with this, cross-sectional correlations between optimism and pessimism in the current sample were small but negative, ranging between -.25 – -.29.

There is also empirical evidence that pessimism and optimism are particularly distinct in older adults with persistent pain. Benyamini (2005) examined pessimism and optimism in elderly osteoarthritis patients and found that about 28% of the sample experienced both low optimism and low pessimism concurrently. Conversely, 17% of the sample experienced both high optimism and high pessimism. Only 57% of the sample constituted “true” optimists or pessimists, with consistency between optimism and pessimism scores (Benyamini, 2005). Hence, levels of optimism would have been inaccurate in about half of participants had optimism and pessimism been conceptualized as a single phenomenon. Furthermore, there were important differences found between these four groups in terms of coping strategies for pain. Specifically, individuals who concurrently aspired for the best (i.e., were optimistic) and expected the worst (i.e., were pessimistic) reported significantly greater use of pain-coping strategies as compared to all other groups (Benyamini, 2005). In line with this, older adults with persistent pain may not experience positive and negative expectancies as opposites. This question should be investigated in future research to determine whether this is specific to older adults with persistent pain or a more generalizable finding.

Although the present findings suggest that negative and positive expectancies are separate concepts in older adults, it is possible that these findings are simply due to measurement error. In line with current findings, some previous factor analytic studies have suggested that the LOT-R should be split into two subscales (i.e., optimism and pessimism; Chang et al., 1994; Herzberg, Glaesmer, & Hoyer, 2006). However, other factor analytic studies have suggested that it should be modeled as a unidimensional construct (Chiesi, Galli, Primi, Innocenti Borgi, & Bonacchi, 2013; Kubzansky, Kubzansky, & Maselko, 2004; Segerstrom, Evans, & Eisenlohr-Moul, 2011) and have argued that factor structures of this measure which separate optimism and pessimism are simply displaying a method effect (i.e., positively- versus negatively-worded items; Chiesi et al., 2013; Monzani, Steca, & Greco, 2014; Rauch et al., 2007). While it is possible that the current findings could be driven by a method effect, optimism and pessimism demonstrated meaningful differences in association with pain-related outcomes. If findings were simply due to method effects, then one would expect few substantive differences in associations. Hence, this likely demonstrates conceptual differences.

What is unique about negative expectancies?

In the present study, positive and negative expectancies were best modeled as distinct, but related concepts, and results suggested that only negative expectancies predicted changes in pain-related outcomes over time. Why might negative expectancies predict pain trajectories whereas positive expectancies do not?

These results may have emerged due to the pain-related outcome measures under investigation. Specifically, the current study examines the associations between trait expectancies and the trajectories of various “negative” symptoms, or maladaptive outcomes, that can accompany persistent pain (i.e., pain severity, pain interference, disability, and depressive symptoms). As such, the current results may reflect concordance between negative expectancies and negative outcomes. However, had this study also investigated the associations between trait expectancies and "positive" or adaptive outcomes in those with persistent pain (e.g., happiness, health-related quality of life, subjective well-being, life satisfaction, resilience, social support, physical activity) results may have differed.

This hypothesis is in line with the justification for the positive psychology movement. Positive psychologists suggest that viewing humans through a deficit model inherently skews and restricts our understanding of health (Lee Duckworth, Steen, & Seligman, 2005; Seligman & Csikszentmihalyi, 2014; Sheldon & King, 2001). Also focusing our attention on positive affective and cognitive processes (such as positive expectancies) may help us to understand the counterpart to human suffering: human flourishing. The current study examined how older adults' undesirable pain-related outcomes change over time. It could be argued that this study views pain trajectory through a deficit model. Adults with persistent pain have goals and values apart from simply managing pain symptoms (Becker, 2020; Gardner et al., 2015). Therefore, psychologists should also have a vested interest in the psychological variables that help individuals to live meaningful lives, despite pain. Considering this, positive expectancies may be associated with flourishing outcomes in those with persistent pain; whereas, negative expectancies may be associated with maladaptive outcomes due to pain. Thus, the current study does not suggest that positive expectancies are unimportant in the context of persistent pain in older adulthood as it presents a biased view of the effects of expectancies on the lives of these individuals. Future research should aim to investigate the relationships between expectancies and human flourishing outcomes in older adults with persistent pain to examine this idea.

Alternately, negative trait expectancies may simply be "stronger" cognitions than positive trait expectancies (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). In lay terms, it may be more harmful to believe in a negative future than it is helpful to believe in a positive future. This notion is in line with a model for chronic pain adjustment proposed by Geisser, Robinson, and Riley (1999) which calls for pain researchers and clinicians to "focus more on the negative." This model proposes that maladaptive coping and beliefs are the primary determinants of adjustment to chronic pain and are more highly related to pain outcomes than adaptive coping and beliefs (Geisser et al., 1999). Moreover, this model posits one caveat: that the perception of control over one's pain is the only "adaptive" belief that is highly influential of adjustment to chronic pain. The current findings demonstrate that negative expectancies and health-related perceived control, but not positive expectancies, are associated with the course of pain, which directly aligns with Geisser and colleagues (1999) model of adjustment to chronic pain.

The theory of negativity bias also supports the notion that negative expectancies are more powerful than positive ones (Rozin & Royzman, 2001). This theory posits that negative entities (e.g., events, personality traits, etc.) are more influential than positive entities in both humans and animals due to the principles of negative potency and negativity dominance. Negative potency suggests that negative events are more salient and have a stronger effect on individuals, even when comparing negative and positive events that are equal in magnitude (Rozin & Royzman, 2001). For example, losing 100 dollars may have a more profound impact on affect than winning 100 dollars due to loss aversion (Tversky & Kahneman, 1991). Negativity dominance suggests that when taking a holistic view of one's life, even if the number of positive and negative events is mathematically equal, one will perceive their life as being more negative (Rozin & Royzman, 2001). For example, gaining a family member and losing a family member mathematically cancel out. However, if one experienced the birth of one child and the death of another child, the magnitude of gaining and losing a child would not equal out as they would likely feel immense grief.

The principles in negativity bias can also be used to explain the current findings. That is, expecting an inherently negative future may be more potent than expecting a positive one and be more influential of cognitions, behaviors, and affect. Additionally, even if one has equal levels of both positive and negative expectations for the future, they may dwell more upon the negative aspects of the future rather than the positive. Generally, having positive expectations may confer fewer benefits in the context of pain as compared to the detriments driven by negative expectations. This idea is reflected in the way in which psychologists treat chronic pain using cognitive behavioral therapy. One core component of this treatment is to shape patients' thoughts from being negative and distorted (e.g., "I can't take this pain anymore! It will never end.") to more logical and realistic (e.g., "This pain is unpleasant now, but it will subside. I can take steps to manage it."; Ehde, Dillworth, & Turner, 2014). As these negative and distorted thoughts dissipate, depression and chronic pain improves. However, it may not be necessary for therapists to change patients' thoughts to be inherently positive to improve the lives of those with chronic pain. The current study suggests that negative expectancies may be a signal for maladaptive adjustment to chronic pain and should be addressed; however, positive expectancies may not provide additional benefits.

The current findings are consistent with recent research comparing the effects of positive and negative expectancies on physical health. A recent meta-analysis by Scheier and colleagues (2021) analyzed the results of 61 studies comparing the effect of optimism and pessimism on objective measures of physical health (i.e., disease incidence, hospitalization, mortality, and biomarkers like blood pressure). Mirroring the current findings, this meta-analysis found that pessimism had more robust associations with physical health as compared to optimism in mainly cross-sectional and longitudinal studies, although these associations were quite small at $r = .029$ and .011 respectively (Scheier et al., 2021). The seemingly larger effect sizes between negative expectancy and pain-related outcomes (i.e., $r = .08$-.19) in the current, large-scale, longitudinal study suggests that negative expectancies may be particularly formative in the experience of pain, compared to other health issues.[6]

Current findings are also consistent with a 2020 re-analysis of a 2012 study suggesting a relationship between optimism and mortality (Mosing et al., 2012; Whitfield, Zhu, Landers, & Martin, 2020). In the 2012 study, researchers found a positive relationship between optimism (as measured by the total score of the LOT) and longevity (Mosing et al., 2012). However, authors re-analyzed this data by directly comparing the effect of optimism (as measured by the optimism subscale of the LOT) and pessimism (as measured by the pessimism subscale of the LOT) on mortality and found that pessimism was associated with greater all-cause and cardiovascular mortality, but optimism was not (Whitfield et al., 2020). These findings suggest that pessimism may drive the relationship between optimism and mortality when optimism and pessimism are considered a unidimensional construct. Previous research to date connecting positive expectancies to pain may be due to negatively worded items within measurements of positive expectancy driving this relationship.

Of note, the current analyses examined the *unique* associations between trait expectancies and changes in pain-related outcomes. That is, path analyses were modeled to examine the

[6] Of note, these two studies may not be directly comparable as the current study did not use "objective" measures of pain because, at present, there are no validated objective measures of pain (Cowen, Stasiowska, Laycock, & Bantel, 2015).

amount of variance in pain-related outcomes that were explained by the unique properties of negative and positive expectancies while controlling for their shared variance. Thus, the current findings do not suggest that positive expectancies have no influence on pain over time. Rather, positive expectancies may be predictive of changes in pain over time when including their shared variance with negative expectancies. This may explain why, in the current dataset, when positive expectancies are modeled as the sole predictor of changes in pain over time, they demonstrated small correlations with changes in pain severity, pain interference, and depressive symptoms. That is, the shared variance between positive and negative expectancies may explain the finding that positive expectancies predict pain on their own, but not when controlling for negative expectancies.

Negative Expectancies Consistently Predict Changes in a Variety of Pain-Related Outcomes

The current findings suggest that negative expectancies have consistent relationships with the course of several pain-related outcomes across long periods of time in older adults with persistent pain. These findings replicate and expand upon previous research by 1) providing more insight into the directionality of the relationship between expectancies and pain and 2) suggesting that negative expectancies may be consistent, prognostic factors in determining the course of a broad array of pain-related symptoms.

First, this work expands upon previous literature by suggesting that a negative outlook of the future predicts a worsening pain experience. Negative expectancies may contribute to poorer pain-related outcomes through principles captured in self-regulation theory (SRT; Carver & Scheier, 2001). SRT suggests that when individuals perceive a desired outcome as likely, they may put more effort into making that desired outcome materialize by engaging in adaptive coping efforts (e.g., active coping, planning, positive reframing). In turn, their engagement in adaptive coping confers a higher likelihood that the desired outcome will occur. Opposite of this, when individuals perceive a desired outcome as unlikely, they may also be unlikely to put much effort toward that outcome by engaging in maladaptive coping (e.g., denial, behavioral disengagement), resulting in the outcome being unfulfilled. Older adults with persistent pain who hold negative generalized expectancies (e.g., “I’ll never get what I want”) may also hold negative, pain-specific expectancies (e.g., “My pain will never get better”). In line with SRT, if one expects little improvement in their chronic pain, they may be more likely to resort to maladaptive coping behaviors like denial or avoidance. In turn, they may actualize this negative expectation through their lack of adaptive efforts to reduce pain.

Moreover, conceptualizing the current findings through this lens could help to explain why only negative expectancies predicted changes in pain-related outcomes over time. Geisser and colleagues (1999) claimed that only maladaptive, not adaptive, coping is predictive of pain outcomes. Assuming that this is true and that engagement in different coping behaviors drives the relationship between expectancies and pain-related outcomes, it would make sense that only negative expectancies contribute to the trajectory of pain across time. That is, according to SRT (Carver & Scheier, 2001), positive expectancies contribute to adaptive coping, and negative expectancies contribute to maladaptive coping. In addition, Geisser and colleagues (1999) argue that only maladaptive coping is predictive of pain trajectories. Thus, only negative expectancies may predict changes in pain-related outcomes over time due to their association with maladaptive coping. This finding suggests that reducing the occurrence of significant negative expectancies may promote less engagement in maladaptive coping and improve pain-related outcomes in older adults experiencing persistent pain.

Second, the current findings suggest that negative expectancies may be indicative of a poor pain prognosis. At present, the literature reviewing one's "typical" pain prognosis provides inconsistent conclusions regarding the trajectory of pain over time. Of course, chronic pain prognoses vary by pain diagnosis (Gore, Sepic, Gardner, & Murray, 1987; Hayden et al., 2010 Papageorgiou, Silman, & MacFarlane, 2002; Radanov, Sturzenegger, & Di Stefano, 1995). However, prognoses for chronic pain may also change over time. Indeed, the rate by which pain symptoms subside varies, with pain improving rapidly close to diagnosis but slowing its rate of change over time (Costa et al., 2012). In line with this, a study of individuals with chronic non-malignant pain found that 85% of participants continued to experience significant chronic pain 12 years later (Andersson, 2004); however, a meta-analysis of pain trajectories in chronic non-malignant pain discovered that participants generally experienced significantly reduced pain within one year (Costa et al., 2012). Accordingly, the literature does not provide a clear, general prognosis for people with chronic pain (Hayden, Chou, Hogg-Johnson, & Bombardier, 2009).

Yet, a generalized chronic pain prognosis may be unclear due to the nature of pain itself. Indeed, pain is a subjective experience that is impacted by several psychosocial factors (Williams

& Craig, 2016). Thus, a prognosis for chronic pain may be best understood in terms of the psychosocial prognostic factors which influence the course of pain. Many prognostic factors show consistent relationships with the course of chronic pain (e.g., number of pain areas, age, sex, compensation, depression; Tunks, Crook, & Weir, 2008). Physicians often rely upon these prognostic factors, but particularly psychosocial factors, in daily clinical practice to make accurate prognoses for individual chronic pain patients (Cedraschi & Allaz, 2005).

The current findings suggest that generalized, negative expectancies may be an additional psychosocial prognostic indicator of the course of pain, such that older adults with persistent pain who hold negative expectancies have a poorer prognosis. Moreover, findings suggest that negative expectancies may be a prognostic factor to consider in long-term pain-related outcomes as they were consistent predictors of pain trajectories at both 2 and 10 years into the future. The consistency of this prospective relationship also suggests that negative expectancies may be a stable predictor of pain prognosis without significant changes in the magnitude of its effect over time. However, this should be explored further in future research by examining the effects of negative expectancy on more immediate changes in pain (e.g., weeks or months). To my knowledge, no prognostic factor has been examined for its ability to consistently predict pain trajectory across varying periods of time, which could be of clinical importance considering the rate of symptom change may vary over time (Costa et al., 2012).

The present findings also suggest that negative expectancies may be predictive of prognosis for both mental and physical health outcomes in older adults with persistent pain (i.e., pain severity, pain interference, disability, and depressive symptoms). Unlike other prognostic factors which may only be indicative of worsening pain severity over time, negative expectancies may be a broader prognostic indicator of what an individual's overall pain experience will be like. These results suggest that expectancies may be particularly important for clinicians to assess and intervene upon at the point of diagnosis, as they appear to have long-standing and pervasive effects on pain outcomes. Furthermore, unlike prognostic factors that are fixed and unmodifiable (e.g., age, sex, number of pain areas, compensation), negative expectancies are malleable and can be changed with relatively brief, cheap, and non-invasive treatments (e.g., cognitive behavioral therapy; Turner, Holtzman, & Mancl, 2007). This prognostic factor may be more useful to assess for than unmodifiable factors as providers can actively change negative expectancies, which may improve the prognosis of individuals with chronic pain.

Health-Related Perception of Control Predicts Changes in Pain

Moderation Analyses

Previous research has demonstrated that the perception of control may be useful for differentiating between different types of generalized expectancies (Shanahan et al., 2020). I originally aimed to examine whether optimism and hopelessness differentially predicted changes in pain at varying levels of perceived control over one's health. This specific aim was no longer achievable after structural models suggested that expectancies should be conceptualized in terms of their valence (i.e., positive versus negative). Despite this, moderation analyses were conducted to examine whether perceived control interacted with the valence of the expectancy in predicting changes in pain. These analyses demonstrated inconsistent results across samples and difficulties replicating within samples. Thus, the presented moderator analyses were not grounded in theory, appeared to be unreliable, and should be interpreted with caution.

Nevertheless, two moderators demonstrated moderate consistency and are worth noting. First, perceived control over health moderated the relationship between optimism and 10-year changes in disability such that greater optimism was associated with less disability over time in those with high levels of control over their health. For those with low perceived control over their health, optimism was associated with greater disability over time. Second, perceived control over health moderated the relationship between optimism and 10-year changes in pain severity. For those with high perceived control over their health any level of optimism was associated with reductions in pain severity over time. However, for those with medium to low perceived control, greater optimism was associated with worsening pain severity over time.

These significant moderators could be explained through the impact of control and expectancy on health management behaviors. Specifically, if one believes in a positive future and perceives that they have high levels of control over improving their health, they may be more likely to actively engage in treatments for pain, thus effectively managing their pain severity and pain-related disability. However, those with low perceived control over their health and high optimism may believe that there is little they can do to manage the pain but feel optimistic that the pain will resolve in the future. This complacency may delay efforts to manage pain or seek medical care. In turn, unmanaged and untreated persistent pain may become more severe over time and increase pain-related disability. These significant moderations may also be due to Type I error. There were no alpha corrections used for moderation analyses to reduce the chance of false positive results. However, had a more conservative p-value estimate (e.g., .01) or a Bonferroni alpha correction (Bland & Altman, 1995) been used, these moderations effects would not have been significant. Therefore, these moderators should be replicated in future research to ensure that they were not spurious.

Post-Hoc Analyses

Considering significant concerns about the validity and reliability of moderation results, post-hoc analyses were conducted to better understand the associations between health-related perceived control and prospective pain-related outcomes. These analyses suggested that the perception of control over one's health significantly predicted pain trajectories, even when controlling for the effects of generalized expectancies. Specifically, perceiving that one had greater control over their health was significantly associated with less disability, pain interference, pain severity, and depressive symptoms over time.

These findings are in line with previous literature suggesting that generalized perceived control is associated with better physical and mental health outcomes (Seligman, 1972; Wallston, Wallston, Smith, & Dobbins, 1987). Moreover, they align with a recent study using the HRS which found that generalized perceived control is associated with some physical, behavioral, and psychological indicators of health in older adults longitudinally (Hong et al., 2021). Furthermore, a potentially overlapping concept with one's health-related perception of control is one's health locus of control (HLOC). Previous research has demonstrated that holding an internal HLOC (i.e., believing that one's health is personally controllable) is similarly related to adaptive chronic pain outcomes. For example, holding an internal HLOC has been associated with fewer depressive symptoms and less disability for those with chronic pain (Campbell et al., 2017; Oliveira et al., 2008; Wong & Anitescu, 2017). It is also associated with pain treatment. Holding an internal HLOC is associated with better treatment engagement, adherence, and outcomes (i.e., better mental and physical health, lower pain intensity, and a higher likelihood of returning to work; Härkäpää, Järvikoski, Mellin, Hurri, & Luoma, 1991; Keedy, Keffala, Altmaier, & Chen, 2014; Torres et al., 2009; Zuercher-Huerlimann et al., 2019). Thus, the current findings support previous research suggesting that health-related perceived control correlates with pain-related outcomes.

Like generalized expectancies, perceived control may also relate to pain outcomes through its facilitation of approach coping. In chronic pain samples, greater perceived control over one's pain has been associated with greater engagement in approach coping (e.g., coping self-statements, acceptance, physical activity, information seeking) and less engagement in avoidance coping (e.g., ignoring pain, diverting attention; Buckelew et al., 1990; Chiros & O'Brien, 2011; Crisson & Keefe, 1988; Haythornthwaite, Menefee, Heinberg, & Clark, 1998; Jensen & Karoly, 1991). In turn, increased engagement in approach coping and reduced engagement in avoidant coping may lead to improvements in pain outcomes over time (Peres & Lucchetti, 2010).[7]

The relationship between perceived control and coping may also be understood through the implicit theory framework (Dweck, Chiu, & Hong, 1995; Summers, Higgins, Te, Byrne, & Chipchase, 2019). The implicit theory framework is a social-cognitive theory that posits that the extent to which one believes that humans are capable of change influences their understanding of cause and effect, and leads to different behavioral reactions (Dweck et al., 1995). Those who believe that change is possible are proposed to hold an "incremental theory"; whereas, those who do not believe in change hold an "entity theory" (Dweck et al., 1995). This theory has been proposed to relate to the experience of pain (Higgins, Bailey, LaChapelle, Harman, & Hadjistavropoulos, 2015; Summers et al., 2019). For example, individuals who believe that their chronic pain is fixed and uncontrollable may attribute their understanding of cause and effect to this fixed "trait" (e.g., "I can't socialize with my friends because of my pain.") leading to engagement in avoidant coping. Yet, individuals who believe that their chronic pain is malleable may attribute their understanding of cause and effect to the specific context (e.g., "I can't go hiking with my friends because trail is too rugged…") leading to engagement in approach coping (e.g., "…but I will meet them for dinner afterward.").

The perception of control over one's health may be an extension of one's implicit theory. In line with this, perceptions of control over pain have strong, positive correlations with incremental theory and strong negative correlations with entity theory (Summers et al., 2019).

[7] Of note, some forms of avoidance coping, such as distraction, have been shown to be particularly effective in coping with pain (Johnson, 2005). However, these strategies may be better suited for coping with acute, rather than chronic pain. In fact, there is little evidence that distraction is a suitable long-term coping mechanism for chronic pain, with some studies suggesting that chronic pain patients using distraction may have more intense pain (Cioffi & Holloway, 1993; Johnson, 2005; Keefe & Williams, 1990). Furthermore, approach style mindfulness coping strategies, which involve focusing in on (rather than distracting the self from) bodily sensations, appear to be associated with less intense pain in chronic pain samples (Hilton et al., 2017).

Additionally, the perception of control over pain and incremental theory are similarly associated with pain severity and disability in those with chronic low back pain (Summers et al., 2019). Moreover, people with chronic pain who hold an incremental theory of pain use more active coping strategies and have better pain-related outcomes compared to those with an entity theory of pain; whereas, entity theory is associated with increased catastrophizing, depressive symptoms, and pain expression (Higgins et al., 2015). Thus, holding an incremental theory may be inherently associated with one's specific perception of control over their health and lead to better health outcomes through the facilitation of approach coping.

Post hoc findings add to our understanding of the relationship between health-related perceived control and pain in several ways. First, current findings help to explain the directionality of these relationships. The limitations brought about by pain severity, disability, or depression could lead to a lower sense of control regarding one's health. However, current results suggest that the perception of control is associated with the way in which symptoms change over time. Hence, perceived control may predict (or at least have bidirectional associations with) pain-related outcomes. Second, perceived control appears to be associated with pain trajectories across long spans of time but may also be a more robust proximal predictor of changes in pain. This study found that the perception of control was associated with less pain severity and pain interference at 10-year follow up, but was associated with less pain severity, pain interference, disability, and depressive symptoms at 2-year follow up. Thus, negative *generalized* expectancies retained similar associations at 10- and 2-year follow up while *specific* perceived control did not. Results may be due to specific beliefs being more apt to change over time as compared to generalized beliefs. Third, perceived control may be a factor to consider for pain trajectories in older adulthood specifically. At present, theories of perceived control propose that its relationships with psychosocial outcomes change throughout the lifespan, particularly in older adulthood (Jacelon, 2007). However, research has demonstrated that perceived control is similarly related to pain in younger and older adults (Elliott, 2009). In fact, a longitudinal study suggested that perceived control may be more robustly associated with health in older adults, as compared to middle aged adults (Infurna, Gerstorf, & Zarit, 2011). The current findings provide additional evidence that the perception of control may impact the health trajectories of older adults.

Study Limitations

There are limitations concerning the present study methodology. For example, the current sample included all older adults within the HRS dataset who indicated that they experienced "persistent pain" within the past year. Hence, the inclusion criteria were broad, did not include objective cut-offs for the chronicity or intensity of pain, and did not require participants to endorse a diagnosis of any pain disorder (e.g., fibromyalgia). There were pros and cons to this decision. Having broader inclusion criteria meant that I could not draw specific conclusions regarding the relationships between expectancies and any given pain diagnosis. However, considering that negative expectancies produced consistent relationships with pain-related outcomes in this broad pain sample, the current results suggest that expectancies may be relevant to the pain experience more generally.

There are also measurement-based limitations. There is some ambiguity with what the current study's measure of "hopelessness" is capturing. Previous studies have referred to this measure as hope (Long et al., 2020); whereas, this study referred to the concept as hopelessness, or the absence of hope. Previous studies have found that, despite lexical similarities, hope and hopelessness are not interchangeable concepts (Huen, Ip, Ho, & Yip, 2015). Conflating these concepts could lead to erroneous interpretations of results. Moreover, the current study found that expectancies were best conceptualized in terms of their valence (i.e., positive or negative) and that only questions regarding a belief in a negative future were significantly related to pain. Hence, the current interpretation of this measure as "hopelessness" appears to be appropriate. Additionally, this study only included one measure of generalized positive expectancies (i.e., optimism). However, other types of generalized positive expectancies (e.g., hope and self-efficacy) have theoretical and empirical associations with pain-related outcomes (Jackson et al., 2014; Shanahan et al., 2021). It is possible that other types of generalized positive expectancies are indeed associated with changes in pain outcomes, whereas optimism is not.

Outcome measures used in this study also come with limitations. Measures of pain severity and pain interference were both single item measures with pain interference as a dichotomous variable. This type of measurement is not ideal and likely does not capture fully the true range of pain severity and pain interference in the current sample. Future studies should use gold-standard, comprehensive assessments of overall pain experience (e.g., McGill Pain Questionnaire; Turk & Melzack, 2011). For the current measurement of depression, CES-D-8 items prioritize affective aspects of depression (i.e., feelings of depression, feelings of sadness, feelings of loneliness, feeling happy, and enjoying life) over cognitive (i.e., inability to get going, feeling as if everything is an effort) and somatic aspects (i.e., restless sleep). Considering older adults with medical comorbidities tend to experience high depressive somatization (Drayer et al., 2005), the CES-D-8 may not accurately capture levels of depression in the current sample. Notwithstanding these concerns, validation studies have suggested the CES-D-8 is an appropriate measure of depression for older adults (Karim et al., 2014), and scores on the CES-D-8 in the current study were able to significantly differentiate between those with and without a diagnosis of MDD.

Present analytic findings also came with limitations. This study used longitudinal data from an epidemiological dataset. Given this, there was significant attrition between timepoints and missing variables. Incomplete and missing data could impact results, especially if data were not missing at random. However, variables associated to missingness were identified, missingness was determined to be MAR, and FIML was conducted using MLR to account for missing data to maximize power and decrease the chance of missing variables unduly affecting results (Muthén & Muthén, 2017b). Additionally, Aim 1 findings were not hypothesized and significantly impacted the results for the remainder of the study. Given Aim 1 results, the original analyses proposed for Aim 3 were no longer theoretically relevant, resulting in inconsistent and non-significant findings. Thus, these findings should be interpreted with caution. Post-hoc analyses examining the impact of the perception of control while controlling for the impact of generalized expectancies likely provides a more accurate picture of how the perception of control and expectancies influence pain-related outcomes in older adults with persistent pain.

Study Implications

The present study replicated and expanded upon the current literature by demonstrating that negative expectancies were stable predictors of changes in mental and physical health outcomes in older adults with persistent pain over long periods of time. Much of the current longitudinal research connecting expectancies and pain takes place over a few weeks to months (Cimpean & Matu, 2018; Lopez-Olivo, 2011). By examining these connections over years, this study provides evidence of the long-term impact of negative expectancies on the trajectory of pain-related outcomes in older adults. Additionally, this study provides evidence that negative expectancies are predictive of a variety of pain-related outcomes in older adults, suggesting that negative expectancies may be predictive of a poorer overall pain prognosis in older adults with persistent pain. Fortunately, clinicians may be able to utilize expectancy interventions to improve chronic pain outcomes over time. To date, short-term expectation interventions (i.e., verbal suggestion, conditioning, and imagery) have been found to modify expectancies and significantly contribute to reductions in pain (Peerdeman, van Laarhoven, Keij, et al., 2016). Moreover, several time-limited, evidence-based psychotherapies for chronic pain (e.g., cognitive behavioral therapy for chronic pain, acceptance and commitment therapy, mindfulness-based therapies) have repeatedly demonstrated their ability to reduce negative expectancies, such as hopelessness, reduce distress, and improve pain-related functioning in randomized controlled trials (Chiesa & Serretti, 2011; Hughes, Clark, Colclough, Dale, & McMillan, 2017; Majeed, Ali, & Sudak, 2019; Sturgeon, 2014; Vlaeyen & Morley, 2005). Interventions aimed at reducing negative expectancies are time-limited, cost-effective, and efficacious in chronic pain populations. Therefore, pain-care practitioners should consider assessing for negative expectancies and utilizing these interventions as appropriate to improve older adult's pain experience.

Additionally, this study contributes to a larger literature base connecting perceived control and health by suggesting that the perception of control over one's health is predictive of changes in pain-related outcomes over long periods of time. As individuals age, they generally perceive less control over their health (Rodin, 1986). The current study suggests that this perceived lack of control could be detrimental to the health of older adults with persistent pain. Thus, identifying ways to increase one's perception of control could lead to better health outcomes longitudinally. Fortunately, previous research demonstrates that individualized patient education and coaching may serve to bolster a sense of control over pain and improve pain-related outcomes (Oliver, Kravitz, Kaplan, & Meyers, 2001). Thus, these types of short-term interventions may be particularly well-suited for older adults with persistent pain. Future research should aim to examine whether individualized patient education and coaching programs improve pain-related outcomes over time through their effect on perceived control. Additionally, engagement in patient-centered treatment programs, such as multidisciplinary pain management, has been shown to increase patients' perception of control over pain (Coughlin, Badura, Fleischer, & Guck, 2000). Future research should examine whether the relationship between engagement in multidisciplinary pain management treatment programs and improved pain-related outcomes is mediated by increases in patients' perceived control.

Conclusions

The present study examined how trait expectancies and health-related perceived control predict 10- and 2-year changes in pain-related outcomes (i.e., pain severity, pain interference, disability, and depressive symptoms) in a large, nationally representative sample of older adults experiencing persistent pain. Results suggest that negative (i.e., pessimism and hopelessness) and positive (i.e., optimism) expectancies are distinct concepts in older adults with persistent pain. Study results also suggest that only negative, not positive, generalized expectancies are consistently associated with worsening pain severity, pain interference, disability, and depressive symptoms over both a 10- and 2-year period. Moreover, results suggest that health-related perceived control is similarly associated with changes in pain-related outcomes over time, even when controlling for the effects of generalized expectancies. This study expands our knowledge of the associations between expectancies and pain by suggesting that 1) negative expectancies may be particularly relevant in predicting one's pain trajectory, 2) negative expectancies predict changes in pain over time, 3) negative expectancies are predictive of both mental and physical pain-related outcomes, and 4) negative expectancies may be an important prognostic factor to consider in older adults with persistent pain. Future research should examine whether short-term interventions aimed at reducing negative expectancies and increasing health-related perceived control are efficacious for improving pain-related outcomes in older adults.

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