

Towards an Integration of the Health Promotion Models of Self-Determination Theory and Theory of Planned Behavior Among People With Chronic Pain

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Purpose: People with chronic pain and related disability often report motivational difficulties with engaging in health-promoting behaviors. Although health promotion models of self-determination theory (SDT) and theory of planned behavior (TPB) have been shown to explain the motivational processes behind health behaviors in the general population, there is limited theoretical research among persons with chronic pain. This study examined the integration of such theories relevant to physical activity and exercise behavior among pain populations. **Research Method:** Secondary data analyses were conducted using cross-sectional surveys from 198 participants with chronic musculoskeletal pain recruited from U.S. clinics and community networks. The primary outcome was self-reported physical activity and exercise participation. Predictor variables included pain intensity, functional disability, and SDT and TPB measures. Hierarchical regression analysis was conducted to examine the associations between these variables. **Results:** Findings demonstrated that in the first step, functional disability was associated with physical activity and exercise; and in the second step, all SDT factors were associated with physical activity and exercise. In the final step of the model, only certain SDT and TPB factors were associated with physical activity and exercise. **Conclusions:** Despite preexisting pain and functional disability, the findings suggest that health behavior factors from both SDT and TPB are associated with physical activity and exercise participation. This line of research should encourage rehabilitation professionals to recommend regular physical activity and exercise, while simultaneously addressing and monitoring the SDT and TPB factors that are well-timed and appropriate for persons with chronic pain through motivation-oriented rehabilitation approaches.

Impact and Implications

This study describes the motivational processes and mechanisms behind participation in physical activity and exercise behavior among people with chronic pain. Examining motivation for physical activity and exercise contributes to the understanding of the reasons for health-promoting behaviors and strategies in pain rehabilitation practice. These SDT and TPB factors relevant to health-promoting behavior may provide targets for mechanisms of action in motivation-oriented rehabilitation intervention programs. Theoretical guidance may also assist practitioners with enhancing motivational components of structured physical activity and exercise programs, rehabilitation psychology interventions, or other rehabilitation services. Although most health promotion interventions

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are driven by theory, such rehabilitation services could be further informed and modulated on the basis of increasingly prominent health behavior theories such as SDT and TPB. Stemming from this study's findings, there are key recommendations for research directions. Future motivation-oriented rehabilitation intervention development and implementation science studies might consider evaluating and targeting SDT factors that are facilitators or barriers to physical activity and exercise at the onset of pain rehabilitation research. The second step in motivation-oriented rehabilitation intervention studies, then, might turn to also evaluating and addressing the time-bound TPB factors most appropriate to people with chronic pain when transitioning from motivation to intention formulation toward regular physical activity and exercise behavior.

Keywords: chronic pain, disability, health behaviors, health promotion, theory

Introduction

Physical activity and exercise are considered an effective approach to managing pain and improving overall health and functionality for people living with chronic pain ([International Association for the Study of Pain, 2017](#)). Despite this, people with chronic pain experience challenges with participation in physical activity and other health promotion strategies and interventions ([Turk & McCarberg, 2005](#)). Lack of interest, low self-efficacy, and fear of reinjury have been identified as some of the key reasons why people with chronic pain fail to follow through with physical activity and exercise goals and programs ([Gatchel & Okifuji, 2006](#); [Gatchel, Peng, Peters, Fuchs, & Turk, 2007](#); [Kerns & Rosenberg, 2000](#); [Kratz, Molton, Jensen, Ehde, & Nielson, 2011](#)). Difficulties with motivation are further complicated when pain and other functional impairment are exacerbated temporarily when taking up a physical activity and exercise routine. Remarkably, however, motivation for physical activity and exercise is not well-described among people with chronic pain ([Brooks, 2014](#)). With improved knowledge of motivation behind health-promoting behavior, rehabilitation professionals may be able to better assist people with chronic pain with identifying and enhancing motivation for regular physical activity and exercise as a component of rehabilitation plans.

Limited research has explored the relationship between motivation and participation in specific health-promoting behaviors among persons with chronic pain. However, theoretical models describing potential predictors of behavioral engagement have been developed for the general population, and growing evidence has supported their utility in describing how persons might become motivated to engage in health-promoting behaviors such as physical activity. Such models include self-determination theory (SDT; [Ryan & Deci, 2000](#)) and the theory of planned behavior (TPB; [Ajzen, 1988](#)).

Self-Determination Theory and Theory of Planned Behavior

Self-determination theory provides a general framework for understanding human motivation ([Deci & Ryan, 2002, 2012](#)). In SDT, there are three distal, inherent needs of autonomy, competency, and relatedness that, if satisfied, promote behavioral self-regulation, optimal functioning, and growth ([Ryan & Deci, 2000](#)). When autonomous, people initiate and regulate health behaviors with a high degree of volition. Competency is the need to be

effective and exercise capacities to seek out optimal challenges toward increasing skills and subsequent opportunities. When the basic need for relatedness is met, people identify with being emotionally connected and interpersonally involved in warm, caring relationships. Research has demonstrated that these distal SDT factors distinguish between active and inactive adults ([Landry & Solmon, 2004](#); [Markland, 1999](#)), are linked to greater frequency of weekly exercise participation ([Wilson, Rodgers, Fraser, & Murray, 2004](#)), and may partially explain the reasons behind physical activity and exercise participation ([Edmunds, Ntoumanis, & Duda, 2006](#); [Pelletier, Fortier, Vallerand, & Briere, 2001](#); [Teixeira, Carraça, Markland, Silva, & Ryan, 2012](#)).

The theory of planned behavior ([Ajzen, 1988](#)) postulates that the intention to perform a health behavior in the immediate future is determined by proximal factors of attitudes, subjective norms, and perceived behavioral control. Attitudes describe the perceived likelihood for and appraisal of consequences to performing a health-promoting behavior in a timely manner ([Ajzen, 1988](#)). Subjective norms refer to the perceptions of social standards that influence desires to comply with those standards in the near future. Finally, perceived behavioral control refers to the presence of factors that would make it easier or harder to timely perform a certain behavior. The TPB has been widely used for assessing and determining health behavior outcomes ([Albarracín, Johnson, Fishbein, & Muellerleile, 2001](#); [Cooke & French, 2008](#)), including physical activity and exercise in the general population (e.g., [Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003](#); [McEachan, Conner, Taylor, & Lawton, 2011](#)). Preliminary studies have also shown TPB constructs are associated with physical activity and exercise outcomes among people with painful medical conditions, including cardiovascular disease (e.g., [Blanchard et al., 2003](#)), spinal cord injury ([Latimer & Martin Ginis, 2005](#)), and peripheral arterial disease ([Galea & Bray, 2006](#)).

Although evidence demonstrates SDT and TPB are independently associated with physical activity and exercise participation, research also suggests the shortcomings to each theory. [Chatzisarantis, Hagger, and Smith \(2007\)](#) proposed that SDT does not identify the transitional processes by which motivations become intentions or goals. This indicates that self-determination alone is not sufficient to lead to behavior change. Persons might, instead, need to develop a sense of time-bound attitudes, subjective norms, and behavioral control prior to formulating specific, measurable, achievable, relevant, and timely intentions for engaging in a target behavior, which is aligned with the tenets of the theory of planned

behavior (Hagger, 2009). A recent meta-analytic study combined research findings from tests of integrated SDT and TPB models that included physical activity and other health behavior outcomes and reported that the expanded health promotion model accounted for 58% of the variance in health behavior change (Hagger & Chatzisarantis, 2009). However, the majority of past research included data from the general population, excluding persons with chronic pain or other disabilities. It is critical, therefore, to further investigate the steps toward integrating SDT and TPB variables relevant to health-promoting behavior among people with chronic pain (Hagger & Chatzisarantis, 2009). Without scientific evaluation, it is difficult for rehabilitation professionals to justify the reasons to select and combine parts of theories or choose one framework over another.

Study Purpose

The focus of SDT is on the quality of generalized motivation that distally affects health behavior (Hagger et al., 2003), whereas TPB posits that intentions and other proximal psychosocial factors largely predict health behaviors within a particular time period and context (Conner, 2008; Conner & Norman, 2005). Integrating SDT and TPB might explain more about the relationships between current levels of motivation and health-promoting behaviors in people with preexisting pain and disability (Hagger & Chatzisarantis, 2009). In this study, our primary research aim was to examine a hierarchical approach to the integration of SDT and TPB factors with self-reported physical activity and exercise participation. Specifically, our research questions included the following:

1. Are SDT factors (i.e., autonomy, competency, and relatedness) associated with physical activity and exercise participation after controlling for preexisting functional disability and pain intensity in a hierarchical model of linear regression?
2. Are SDT and TPB factors (i.e., attitudes, subjective norms, perceived behavioral control, and intentions) associated with physical activity and exercise participation after controlling for all variables in a hierarchical model of linear regression?

We hypothesized that SDT factors would be associated with physical activity and exercise participation after controlling for pain and functional disability. We also hypothesized that both SDT and TPB factors would be associated with physical activity and exercise participation after controlling for all variables. While physical activity and exercise and other health promotion interventions for people living with chronic pain show potential, persistent issues with motivation remain for this population. It is important for rehabilitation professionals to better understand the relevant health promotion theories that explain motivational processes and mechanisms. Increased knowledge of these theories might inform the improvement or development of motivation-oriented rehabilitation and health promotion interventions for persons with chronic pain.

Method

Participants

One hundred ninety-eight persons with chronic pain conditions participated in a cross-sectional, online survey for this secondary data analysis study. Inclusion criteria included (1) 18 years or older; (2) a diagnosis of chronic musculoskeletal pain; (3) nonmalignant pain; and (4) living with pain for more than three months. We also considered potential participants to be eligible if individuals self-reported any wide-ranging abilities to participate in at least some degree of physical activity and exercise. Exclusion criteria included participants younger than 18 years old, reported malignant pain, or were unable to engage in some type of physical activity and exercise. Participants were recruited through forwarded e-mail announcements and posted flyers at the following networks: (1) chronic pain and fibromyalgia support groups in the Midwestern and Southwestern regions of the United States; and (2) outpatient pain, physical therapy, and primary care clinics in the Midwestern region of the United States. Participants did not have direct contact with support group facilitators or health care providers for the purposes of study recruitment or enrollment. Study protocol was approved by the institutional review board at [the University of Wisconsin-Madison].

Measures

Physical activity. The amount of the physical activity and exercise participation was assessed using the Leisure Time Physical Activity Instrument (LTPAI; Mannenkorpi & Hernelid, 2005). The LTPAI is composed of 4 items, which measure time spent on sedentary, light, moderate, and strenuous physical activity and exercise. The response items included the following 3 levels: (1) 0.5 to 1.5 hr a week, (2) 2 to 4 hr a week, and (3) more than 4 hr a week, in which participants provided answers in hours. If no level was selected for a particular category, the number of hours was assigned a value of 0 for that category. For the activity levels, the mean number of hours spent on activities (1, 3, and 5 hr, respectively) was used to calculate the total score, with higher scores indicating greater amounts of time spent in physical activity and exercise. A test-retest reliability estimate was .86 for the total score of the LTPAI (Mannenkorpi & Hernelid, 2005).

Functional disability. Functional limitations were assessed using the World Health Organization Disability Assessment Schedule II (WHO-DAS 2.0 item version). It was designed based on the World Health Organization (WHO) International Classification of Functioning, Disability and Health (ICF; World Health Organization, 2001) to assess the impact of a health condition or disability in terms of functioning. There are a total of 12 items that cover six domains of common daily life activities: understanding and communicating with the world; moving and getting around; self-care; getting along with people; life activities; and participation in society. Items are rated using a 5-point rating scale, from 0 (*no difficulty*) to 4 (*extreme difficulty/cannot do*), providing a range from 0 (no disability) to 48 (maximum disability) for the total score. The Cronbach's alpha for WHO-DAS 2.0 was reported to be .94 (Carlozzi et al., 2015). For the current study, the Cronbach's alpha was .90.

Pain intensity. Pain intensity was assessed with the 1-item 0–10 Numeric Rating Scale (NRS). It was designed by McCaffery

and Beebe (1993) to measure pain severity. Average pain intensity during the past week is rated using a 10-point rating scale, from 0 (*no pain*) to 10 (*pain as bad as it could be*). The 0–10 NRS has been validated across a broad range of pain conditions (Hoffman, Sadosky, Dukes, & Alvir, 2010; Jensen, Smith, Ehde, & Robinsin, 2001; Zelman, Hoffman, Seifeldin, & Dukes, 2003). The 0–10 NRS also demonstrates associations with other pain intensity measures, supporting its validity (Jensen, Turner, & Romano, 1994; Jensen, Turner, Romano, & Fisher, 1999).

Autonomy. Autonomy was measured by the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004). We used the relative autonomy index (RAI) to provide a summary score for perceived autonomy with respect to physical activity and exercise. The RAI was calculated by weighting each subscale and summing the weighted scores: (amotivation multiplied by -3) + (external regulation multiplied by -2) + (introjected regulation multiplied by -1) + (identified regulation multiplied by 2) + (intrinsic regulation multiplied by 3), with higher total scores indicating greater levels of autonomy. The original 19-item BREQ had a total of five motivation subscales, including amotivation (e.g., “I don’t see the point in engaging in physical activity and exercise”), external regulation (e.g., “I engage in physical activity and exercise because other people say I should”), introjected regulation (e.g., “I feel guilty when I’m not engaging in physical activity and exercise”), identified regulation (e.g., “I’m engaged in physical activity and exercise because I value the benefits”), and intrinsic motivation (e.g., “I engage in physical activity and exercise because it’s fun”). Each item is rated on a 5-point Likert-scale, from 0 (*Not true for me*) to 4 (*Very true to me*). The Cronbach’s alphas have been shown to be between .81 and .89 for the subscales (Murcia, Gimeno, & Camacho, 2007). For the current study, the Cronbach’s alpha was .85.

Competency. Competency was assessed using The Exercise Self-Efficacy Scale designed by Bandura (1997). This scale was developed to assess perceived confidence for performing physical activity and exercise routines regularly (three or more times a week) under various circumstances. It is composed of 18 items and 3 subscales: (a) situational/interpersonal (e.g., “When I have too much to do at home”); (b) competing demands (“After recovering from an illness that caused me to stop engaging in physical activity and exercise”); and (c) internal feelings (“When I am feeling tired”). Items are rated from 0% (cannot do) to 100% (certain can do). After assessment, the items are averaged to obtain a mean score, with higher scores suggesting greater levels of competency. The Cronbach’s alpha for the scale was reported to be .94 (Shin, Jang, & Pender, 2001). For the current study, the Cronbach’s alpha was .96.

Relatedness. Relatedness was assessed using the Friend Support for Exercise Habits Scale/Family Support for Exercise Habits Scale. It was designed by Sallis, Grossman, Pinski, Patterson, and Nader (1987) to measure the perceived social support toward physical activity and exercise behavior. It is composed of 20 items and 3 subscales: (a) exercise encouragement (e.g., “Gave me encouragement to stick with my physical activity and exercise program”); (b) family participation and involvement (e.g., “Discussed physical activity and exercise with me”); and (c) rewards and punishments (e.g., “Criticized me or made fun of me for engaging in physical activity and exercise”). Each item is rated using a 5-point Likert rating scale 1 (*never*) to 5 (*very often*). The

range of possible scores is 10–50, with higher scores indicating greater levels of relatedness. The Cronbach’s alphas were reported to be .61 to .91 (Brooks, 2014). For the current study, the Cronbach’s alpha was .90.

Attitudes. Attitudes toward physical activity and exercise were assessed using six differential adjective scales, reflecting both instrumental (harmful–beneficial, useless–useful, important–unimportant) and affective (unenjoyable–enjoyable, boring–fun, painful–pleasurable) aspects of attitudes (Courneya, Conner, & Rhodes, 2006). The items were preceded with the following stem: “For me, engaging in physical activity and exercise regularly over the next month would be ____.” Responses were made on scales ranging from 1 (*extremely . . .*) to 7 (*extremely . . .*). For example, “For me, engaging in physical activity and exercise regularly over the next month would be extremely boring – extremely fun.” Consistent with Ajzen’s (2002b) guidelines, the 6 items were averaged to obtain a mean attitudes score, with higher scores suggesting better attitudes toward physical activity and exercise. The Cronbach’s alphas were .79 for instrumental attitudes and .87 for affective attitudes. For the current study, the Cronbach’s alpha was .88.

Subjective norms. Following recommendations from Ajzen and colleagues (e.g., Ajzen, 2002a), subjective norms toward physical activity and exercise were measured by using two components: injunctive norms and descriptive norms (Courneya et al., 2006). Injunctive norm is preceded by the statement “I think that if I were to engage in physical activity and exercise regularly over the next month, most people who are important to me would be ____.” This was followed by the three semantic differential scales of disapproving–approving, unsupportive–supportive, and discouraging–encouraging. The three descriptive norm items are (1) “I think that over the next month, most people who are important to me will themselves be ____” (inactive–active); (2) “I think that over the next month, most people who are important to me will themselves engage in physical activity and exercise regularly” (disagree–agree); and (3) “I think that over the next month, the physical activity and exercise levels of most people who are important to me will be ____” (low–high). Responses were made on scales ranging from 1 (*extremely negative*) to 7 (*extremely positive*), and the 6 items were averaged to obtain a mean score. Higher scores indicate a participant’s endorsement of subjective norms. The Cronbach’s alphas were .84 for injunctive norms and .90 for descriptive norms. For the current study, the Cronbach’s alpha was .81.

Perceived behavioral control (PBC). Ajzen (2002a) suggests that perceived behavioral control (or control beliefs) should be measured with unidimensional items in order to increase internal reliability and reduce the complexity of having two separate components for self-efficacy and perceived controllability (Courneya et al., 2006). Following these suggestions, 6 perceived behavioral control items toward physical activity and exercise behavior are preceded with the following stem: “If you were really motivated, ____,” and participants are asked to endorse the following semantic differential scales: uncontrollable–controllable, untrue–true, disagree–agree, difficult–easy, unconfident–confident, uncertain–certain (e.g., “If you were really motivated, how controllable would it be for you to engage in physical activity and exercise regularly over the next month?”). Responses are made on scales ranging from 1 (*extremely negative*) to 7 (*extremely positive*), and ratings on the 6 items are averaged to obtain

a mean score. Higher scores indicate participants are reporting that engagement in physical activity and exercise is under their control, if motivated. The Cronbach's alpha for the PBC scale was .91 (Courneya et al., 2006). For the current study, the Cronbach's alpha was .93.

Intentions. Courneya et al. (2006) developed questions to measure behavioral intentions for physical activity and exercise. The three intention items are (1) "How motivated are you to engage in physical activity and exercise regularly over the next month?" (unmotivated–motivated); (2) "I strongly intend to do everything I can to engage in physical activity and exercise regularly over the next month" (untrue–true); and (3) "How committed are you to engaging in physical activity and exercise regularly over the next month?" (uncommitted–committed). Each item is rated using a 7-point Likert scale ranging from 1 (*extremely negative*) to 7 (*extremely positive*), and the 3 items are averaged to obtain a mean score. Higher scores suggest that participants are reporting intentions to engage in physical activity and exercise. The Cronbach's alpha for the original scale was .95 (Courneya et al., 2006). For the current study, the Cronbach's alpha was .94.

Data Analysis

The Statistical Package for the Social Sciences Version 23 (SPSS; IBM Corp., 2016) for Windows was used for all data analyses. The data were screened for missing data, outliers, and normality. Less than 10% of the data were missing. However, to include as many participants as possible for the data analyses, mean substitution at the item level was used to estimate missing values. The presence of multicollinearity was assessed by examining the variance inflation factors (VIF) and tolerance. None of the VIF values exceeded 10 for any variables in the analyses (range = 1.03 to 2.71), and none of the tolerance values were less than .10 (range = .37 to .96). This suggests that there was no evidence for multicollinearity in the data and that there would not be significant changes in the coefficients after adding or deleting variables from the dataset.

Descriptive characteristics were analyzed using frequencies, percentages, means, and standard deviations. Correlational techniques were used to assess relationships between predictor and outcome variables in the multiple linear regression analyses. Values and change in R^2 (ΔR^2); unstandardized regression coefficients (B) and 95% confidence intervals (CI); standard errors of unstandardized regression coefficients ($SE B$); and standardized regression coefficients (β) were calculated using a hierarchical model of multiple linear regression. The model was conducted with physical activity participation as the outcome variable and three sets of predictor variables entered in sequential steps based on a specified hierarchy: (a) preexisting characteristics (i.e., functional disability and pain intensity); (b) distal variables from the self-determination theory (i.e., autonomy, competency, and relatedness); and (c) proximal variables from the theory of planned behavior (i.e., attitudes, subjective norms, perceived behavioral control, and intentions). A p value of $<.05$ was considered statistically significant for parameter estimates.

Results

Descriptive Statistics and Correlations

Among the 198 participants, the average amount of physical activity participation reported was 3.3 hr per week ($SD \pm 1.4$),

with a 1–5 response range. The mean pain intensity score was 6.2 ($SD \pm 1.9$) on the 0–10 rating scale. Nearly 55% individuals reported having fibromyalgia, and 45% reported having another type of chronic musculoskeletal pain condition (e.g., chronic low back pain, osteoarthritis, rheumatoid arthritis). Participants were diagnosed, on average, 13 years prior to the study ($SD = 9.8$) at the mean age of 30 ($SD = 12.5$). The mean functional disability score was 1.8 ($SD \pm .0.8$), with a 0–5 response range. The mean autonomy score was 29.4 ($SD \pm 29.7$), with a -49.0 – 80.0 response range. The mean competency score was 76.7 ($SD \pm 44.3$), with a 1–100 response range. The mean relatedness score was 4.5 ($SD \pm 1.7$), with a 1–7 response range. The mean attitudes score was 4.8 ($SD \pm 1.3$), with a 1–7 response range. The mean subjective norms score was 5.0 ($SD \pm 0.9$), with a 1–7 response range. The mean perceived behavioral control score was 4.7 ($SD \pm 1.5$), with a 1–7 response range. The mean intentions score was 4.7 ($SD \pm 1.7$), with a 1–7 response range.

The majority of participants were women (86.7%), and the age range for participants was from 18 to 82 ($M = 43.4$, $SD = 14.4$). Most participants identified themselves as White/Caucasian (89.1%), followed by Black/African American (4.3%) and Native American (2.4%). For education level, the majority had completed high school (98%), and over half had earned a college degree (59.7%). More than half of the participants were married or in a long-term relationship (59.7%), nearly a quarter (27.0%) reported being single, and the rest were divorced (10.0%) or widowed (1.4%). The median annual household income for all participants was USD \$42,500 ($M = \$48,425$, $SD = \$46,455$). In terms of employment, 41.2% were employed in either full-time or part-time jobs, 36.5% described themselves as retired or not seeking employment, 16.1% were seeking employment, and 5.6% were identified as volunteering.

Correlations between the predictor variables and physical activity and exercise participation outcome are shown in Table 1.

Hierarchical Model of Multiple Linear Regression

Table 2 presents the results from the hierarchical model of multiple linear regression. In the first step of the hierarchical model, functional disability and pain intensity were entered. This set of variables accounted for a significant amount of variance in physical activity and exercise participation, $R = .255$, $R^2 = .065$, $F(2, 195) = 6.790$, $p < .01$. Examining the standardized partial regression coefficients, functional disability was found to be significantly associated with physical activity and exercise participation ($\beta = -.273$, 95% CI $[-.426, -.119]$).

Self-determination theory variables (i.e., autonomy, competency, and relatedness) were entered in the second step. These predictor variables accounted for a significant increase in variance of physical activity and exercise participation beyond that explained by the previous set of variables, $R = .572$, $R^2 = .327$, $\Delta R^2 = .262$, $F(3, 192) = 18.635$, $p < .001$. Autonomy ($\beta = .174$, 95% CI $[.025, .324]$), competency ($\beta = .332$, 95% CI $[.178, .485]$), and relatedness ($\beta = .199$, 95% CI $[.076, .323]$) were significantly associated with physical activity and exercise participation.

In the third step, TPB variables (i.e., attitudes, subjective norms, perceived behavioral control, and intentions) were entered. These variables accounted for a significant increase in variance of phys-

Table 1

Correlations, Means, and Standard Deviations for Variables Used in Hierarchical Regression Analysis ($N = 198$)

Variables	1	2	3	4	5	6	7	8	9	10
1. Physical activity and exercise participation	—									
2. Functional disability	-.252***	—								
3. Pain intensity	-.080	.459***	—							
4. Autonomy	.439***	-.314***	-.119*	—						
5. Competency	.512***	-.350***	-.140*	.614***	—					
6. Relatedness	.348***	-.211**	-.093	.242***	.296***	—				
7. Attitudes	.475***	-.456***	-.235***	.734***	.550***	.379***	—			
8. Subjective norms	.135*	-.224**	-.063	.241***	.290***	.517***	.331***	—		
9. Perceived behavioral control	.314***	-.471***	-.318***	.468***	.457***	.341***	.644***	.333***	—	
10. Intentions	.471***	-.333***	-.136*	.686***	.678***	.391***	.733***	.357***	.606***	—
Mean	9.611	21.798	6.217	29.384	4.278	17.788	4.836	5.020	4.710	4.632
SD	5.210	9.649	1.846	29.736	2.454	8.270	1.249	.926	1.466	1.728

Note. Autonomy, competency, and relatedness are self-determination theory variables. Attitudes, subjective norms, perceived behavioral control, and intentions are theory of planned behavior variables.

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

ical activity and exercise participation beyond that explained by the previous set of predictor variables, $R = .604$, $R^2 = .365$, $\Delta R^2 = .038$, $F(4, 188) = 12.006$, $p < .001$. Attitudes ($\beta = .218$, 95% CI [.005, .431]) and subjective norms ($\beta = -.174$, 95% CI [-.312, -.036]) were significantly associated with physical activity and exercise participation. This final step of the hierarchical model accounted for 36.5% of the total variance in physical activity and exercise participation, which is considered a large effect size according to Cohen's standards for the behavior sciences research (Cohen, 1992).

Discussion

The main purpose of study was to use a hierarchical approach to examining the associations between SDT (i.e., autonomy, competency, and relatedness) and TPB factors (i.e., attitudes, subjective norms, perceived behavioral control, and intentions) with physical activity and exercise participation among persons with chronic pain. As hypothesized, it was found that SDT factors alone and the combined grouping of SDT and TPB factors were significantly associated with physical activity and exercise participation. This is

Table 2

Hierarchical Regression Analysis for Outcome of Physical Activity and Exercise Participation ($N = 198$)

Predictor variable	R^2	ΔR^2	Hierarchical model		
			B	SE B	β
Step 1	.065**	.065**			
Functional disability			-.147	.042	-.273**
Pain intensity			.127	.220	.045
Step 2	.327**	.262**			
Functional disability			-.28	.039	-.053
Pain intensity			.084	.188	.030
Autonomy			.031	.013	.174*
Competency			.704	.165	.332**
Relatedness			.126	.039	.199**
Step 3	.365**	.038*			
Functional disability			-.022	.040	.040
Pain intensity			.114	.188	.188
Autonomy			.008	.017	.017
Competency			.687	.178	.178**
Relatedness			.153	.045	.045**
Attitudes			.909	.451	.218*
Subjective norms			-.981	.394	-.174*
Perceived behavioral control			-.220	.297	-.062
Intentions			.176	.314	.058

Note. $F(2, 195) = 6.790$, $p < .01$ for Step 1; $\Delta F(3, 192) = 18.635$, $p < .001$ for Step 2; and $\Delta F(4, 188) = 12.006$, $p < .001$ for Step 3. Autonomy, competency, and relatedness are self-determination theory variables. Attitudes, subjective norms, perceived behavioral control, and intentions are theory of planned behavior variables.

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

consistent with a meta-analysis on the large effect of the integrated SDT and TPB variables on physical activity and exercise behavior outcomes (Hagger & Chatzisarantis, 2009). Testing and refining a hierarchical model of SDT and TPB may further elucidate the theoretical strengths and weaknesses of both frameworks and provide a more complete account of the motivational processes and mechanisms that are associated with physical activity and exercise participation (Chan & Hagger, 2012).

In the second step of the model after controlling for functional disability and pain intensity, all of the SDT variables (i.e., autonomy, competency, and relatedness) were significantly associated with physical activity and exercise participation. These findings demonstrate the importance of meeting the basic needs for self-determination relevant to physical activity and exercise participation. This is consistent with cross-sectional studies that have shown that self-determined motivation distinguishes physically active from inactive adults (Landry & Solmon, 2004; Markland, 1999; Wilson et al., 2004). After controlling for all of the other variables in the final step, only competency and relatedness (i.e., family and friend support) remained significantly associated with physical activity and exercise participation. This is in line with previous research on the usefulness of competency to health and disability models for physical functioning, health-related quality of life, and overall adjustment (Chiu, Lynch, Chan, & Berven, 2011; Chou, Pruett, Ditchman, Chan, & Hunter, 2009; Vong, Cheing, Chan, Chan, & Leung, 2009). Competency (e.g., self-efficacy) has also been long documented as being useful to motivational enhancement in health promotion interventions for persons with chronic pain and other physical disabilities (e.g., Chiu et al., 2011; Chou et al., 2009; Vong et al., 2009). With respect to relatedness (i.e., friend/family social support), past studies have also supported that perceived social support and related constructs are associated with positive health outcomes (Williams et al., 2006), including participation in exercise (e.g., Eyler et al., 1999; Sallis et al., 1987; Treiber et al., 1991). Additionally, a sense of relatedness could be enhanced through support from rehabilitation professionals as well as a shared commitment to goals and tasks in rehabilitation (Borodin, 1979).

In the final step of model after controlling for functional disability, pain intensity, and SDT factors, the TPB factor of attitudes was associated with physical activity and exercise participation. This is consistent with the preliminary studies on the associations between TPB constructs and active physical activity and exercise participation among persons with chronic pain and other physical disabilities (Blanchard et al., 2003; Galea & Bray, 2006; Latimer & Martin Ginis, 2005). This is also similar to research on attitudes and the related construct of outcome expectancy, which has shown associations with health outcomes such as physical functioning, health-related quality of life, and overall adjustment (Chou et al., 2009). Given that attitudes are based on positive or negative behavioral beliefs about the “likely outcomes of a behavior and the evaluation of these outcomes” (Ajzen, 2002b, p.1), individuals may be more likely to engage in a health behavior if they possess the belief that engaging in the behavior will lead to desirable outcomes (Bandura, 2004). Finally, there was also a negative association found between subjective norms and physical activity and exercise participation, which might suggest a suppression effect. Given the small, albeit positive correlation between subjective norms and physical activity and the large correlation between

subjective norms and relatedness in the correlation matrix, this might suggest that subjective norms are being suppressed by the relatedness variable in the final step.

Clinical Implications

Findings from this study have several implications for health promotion and rehabilitation programs. This study clarified potentially underlying motivational processes and mechanisms behind participation in physical activity and exercise behavior among people with chronic pain. Examining motivation for physical activity and exercise contributes to the understanding of the reasons for health-promoting behaviors and strategies in pain rehabilitation practice.

These SDT and TPB factors relevant to health-promoting behavior may provide specific targets for mechanisms of action in motivation-oriented rehabilitation interventions. Theoretical evidence may also offer rehabilitation professionals guidance for enhancing motivational components in structured physical activity and exercise programs, rehabilitation psychology interventions, or other rehabilitation services. One example of an evidence-based practice that has been shown to lead to improved motivation and health behavioral change outcomes among rehabilitation clients is motivational interviewing (MI; Miller & Rose, 2009). MI is a person-centered, psychosocial intervention that helps clients to reduce ambivalence and increase motivation to change maladaptive behaviors and commit to health-promoting behaviors (Burke, Arkowitz, & Menchola, 2003; Lundahl et al., 2013; Manthey, Jackson, & Evans-Brown, 2011; Miller & Rollnick, 1991). Although MI and most health promotion interventions are driven by theory, such rehabilitation services could be further informed and modulated based on increasingly prominent health behavior theories such as SDT and TPB.

Limitations and Future Research

This is one of the few studies to describe SDT and TPB factors relevant to physical activity and exercise among persons with chronic pain. However, there are several limitations identified in this study that may need to be considered when interpreting the results. First, the study design involved a cross-sectional survey, which prevents conclusions on causality. It is possible that the predictor and outcome variables may be in the reverse orders or steps, and/or may have bidirectional effects. Furthermore, the grouping of measured variables may not be accurate as these sets of behavior theory variables do not always change concurrently. Because several of these variables are often fluctuating, this may also interfere with the results. Second, although this study's preliminary tests did not suggest multicollinearity in the data, there still might be multicollinearity problems when evaluating health promotion models integrating multiple behavior theories. In an effort to limit participant burden, brief measures were selected that may not fully assess the comprehensive aspects of a theoretical construct. Some of the predictor variables measured then might not be as clearly defined and may overlap with other brief measures. The overlapping variables can create problems, since this can lead to ambiguity within the constructs being measured. Third, the self-reported nature of an online questionnaire may lead to reporting bias. For example, participants may have misreported their

physical activity and exercise participation or answered questions in a manner that aimed to seek a favorable response. Lastly, the use of a convenience sample of participants may have biased the representativeness of the total sample. For instance, the majority of the participants were of female gender, higher educational attainment, and self-identified as Whites/Caucasians. We caution generalizing our results to different subgroups and suggest future studies should recruit from diverse populations.

Despite these limitations, the study findings are largely consistent with integrated SDT and TPB models of health promotion (Hagger & Chatzisarantis, 2009). Subsequent work would benefit from exploring other biomedical/physical factors (e.g., pain duration, prescription opioid use), psychological factors (e.g., anxiety, anger, trauma, personality traits, or psychosis), or social factors (e.g., specific forms of social support, including family, friend, and significant other support) relevant to physical activity and exercise given the biopsychosocial nature of chronic pain.

Future research should also consider using a longitudinal design to evaluate how the casual, interactive, or additive effects among the current study variables and other relevant factors interact and influence physical activity and exercise among people with chronic pain over time. For instance, the SDT factors of perceived autonomy, competency, and relatedness relevant to physical activity and exercise might need to be assessed and targeted first at the onset of motivation-oriented rehabilitation intervention development or implementation science studies (Chatzisarantis et al., 2007; Hagger & Chatzisarantis, 2009). These types of generalized feelings or distal orientations toward physical activity might act as psychosocial barriers or facilitators to health behavior change (Deci & Ryan, 2002). For instance, if a person with chronic pain is not confident in his or her ability to engage in a physical activity and exercise routine within varied circumstances, this individual might fail to formulate a behavioral intention or might avoid the intervention altogether (Schwarzer et al., 2003). The second step in motivation-oriented rehabilitation intervention testing, then, might be to turn to also evaluating and addressing the intermediary types of time-bound TPB factors including attitudes, subjective norms, and perceived behavioral control, which might be most pertinent to the timely transition from motivation to intentions. Finally, behavioral intentions of TPB might need to be addressed as the last stage of motivational enhancement through forming a goal, direction, or intention for the desired behavior in intervention studies. Although intentions can vary greatly from a day-to-day basis, if people do not develop explicit, well-defined, time-sensitive goals, changes of habitual behavior patterns are unlikely to occur (Schwarzer et al., 2003).

Conclusion

This study found that health behavior factors from both self-determination theory and theory of planned behavior are associated with physical activity and exercise participation in spite of preexisting pain and other functional limitations. The hierarchical model of integrated health behavior theories might better describe the motivational processes and mechanisms behind physical activity and exercise behavior, which provides support for theories potentially useful for persons with chronic pain. This line of research should encourage professionals in rehabilitation settings to recommend regular physical activity and exercise, while simul-

taneously addressing and monitoring SDT and TPB factors that are well-timed and appropriate for persons with chronic pain through motivation-oriented rehabilitation approaches.

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