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Relationships between self-determination theory and theory of planned behavior applied to physical activity and exercise behavior in chronic pain

Jessica M. Brooks^{a,b}, Kanako Iwanaga^c, Chung-Yi Chiu^d, Brandi Parker Cotton^a, Jon Deiches^c, Blaise Morrison^c, Erin Moser^c, and Fong Chan^c

^aDepartment of Psychiatry, Geisel School of Medicine, Dartmouth College, Lebanon, NH, USA

^bUniversity of North Texas

^cUniversity of Wisconsin-Madison

^dThe University of Illinois at Urbana-Champaign

Abstract

This study examined the relationships between self-determination theory (SDT) and theory of planned behavior (TpB) applied to physical activity and exercise behavior (PA&E) in people with chronic pain. Two hundred and eleven adults with chronic musculoskeletal pain (28 males and 183 females, age range 18 to 82 years, mean age 43 years) were recruited from online support groups and clinic networks in the United States. Participants completed SDT measures relevant to PA&E on perceived autonomy support, autonomy, competence, and relatedness, as well as TpB measures relevant to PA&E on intention, attitudes, subjective norms, and perceived behavioral control. Correlational techniques and canonical correlation analysis were performed to examine the relationships and variance within and between theoretical dimensions. Overall, the SDT set accounted for 37% of the TpB variance and the TpB set accounted for 32% of the SDT set variance. The results indicate there are statistical similarities and differences between concepts in SDT and TpB models for PA&E. Using both empirical guidance and clinical expertise, researchers and practitioners should attempt to select and integrate non-redundant and complementary components from SDT, TpB, and other related health behavior theories.

Keywords

Pain; motivation; self-determination theory; theory of planned behavior; physical activity; exercise

Chronic pain impacts nearly one out of three people – more than those affected by heart disease, diabetes, or cancer – making pain one of the most common chronic conditions in the general population (Institute of Medicine [IOM], 2011). It is imperative that health-related fields identify tools and interventions that are effective, efficient, and cost-effective in

CONTACT: Jessica M. Brooks, Jessica.M.Brooks@dartmouth.edu.

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reducing chronic pain and related physical disability. Clinical practice guidelines recommend that physical activity and exercise (PA&E) are an integral component of pain rehabilitation services (International Association for the Study of Pain [IASP], 2009). Although graded activity and other structured PA&E programs have been shown to benefit persons with chronic pain (López-de-Uralde-Villanueva et al., 2016; Searle, Spink, Ho, & Chuter, 2015), issues with nonadherence or motivational difficulties are poorly understood.

Motivational theories on the underlying mechanisms behind health-related behavior have been investigated (Hagger & Chatzisarantis, 2009) and provide useful frameworks and assessment instruments to motivate and engage participants in PA&E programs. Combining components of multiple health behavior theories to create hybrid or integrated motivational models is also becoming increasingly common (Hagger & Chatzisarantis, 2016; Schwarzer, Lippke, & Luszczynska, 2011). Without proper scientific evaluation, however, it is difficult for researchers and practitioners to justify the reasons to choose one framework over another. Empirical guidance on selecting theories or integrated models is lacking in the health psychology literature.

Self-determination theory (SDT; Deci & Ryan, 1985, 2012) and the theory of planned behavior (TpB; Ajzen, 1991) have become prominent among health behavior theories (Hagger & Chatzisarantis, 2009; Hagger, Chatzisarantis, & Biddle, 2002). SDT argues that motivation for healthy activities such as PA&E is facilitated when the basic needs for autonomy, competence, and relatedness are met. The focus of SDT is on the quality of generalized motivational orientations that affect behavior in a specific context (Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). In contrast, TpB posits that the intention to take a particular health action is determined by attitudes, subjective norms, and perceived behavioral control (PBC). The emphasis of TpB, therefore, is that intentions largely predict behavioral engagement (Conner, 2008; Conner & Norman, 2005). While findings from cross-sectional research do suggest causal pathways between SDT and TpB (Hagger & Chatzisarantis, 2009), the conceptual overlap between components of the two theories (e.g. competency and PBC) is not clear.

The purposes of the present study are: (a) to examine the relationships between the theoretical dimensions of SDT and TpB related to PA&E behavior, and (b) to evaluate the shared variance within and between the theoretical dimensions. Consistent with Hagger and Chatzisarantis's (2009) findings, we hypothesize that there will be significant relationships between dimensions of the two theories. We also hypothesize there will be shared variance within and between the theoretical dimensions. Although emerging research suggests the practical value of theoretical integration, there is a need to critically examine the similarities and differences in content and operationalization of constructs (Hagger, 2009). This information may have implications for assessing motivation and intentions for PA&E behavior, especially among people living with chronic musculoskeletal pain.

Methods

Participants

Participants were recruited by flyers through churches and clinics in the Midwestern United States from November to December, 2013. Email announcements through national chronic pain and fibromyalgia support groups were sent out from February to March, 2014. Exclusion criteria included participants younger than 18 years old, reported malignant pain, or were unable to engage in some type of PA&E were excluded. Study protocol was approved by the institutional review board at the University of Wisconsin-Madison. Out of the 253 participants who started the 30-min survey, 218 completed the survey and had the option to request a \$15 gift card.

Measures

SDT instruments—The Health Care Climate Questionnaire (HCCQ; Williams, Grow, Freedman, Ryan, & Deci, 1996) is a 15-item scale rated from 1 (strongly disagree) to 7 (strongly agree) and measures *perceived autonomy support* related to PA&E from healthcare providers. The Cronbach's alpha for the HCCQ was .95 (Williams et al., 1996). The Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004) is a 19-item scale measuring *autonomy* (intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation) for PA&E and is rated from 0 (not true for me) to 4 (very true for me). The Cronbach's alphas for the BREQ-2 ranged from .73 to .86 (Markland & Tobin, 2004). The Exercise Self-Efficacy Scale (ESES; Bandura, 1997) is an 18-item scale measuring *competency* in performing PA&E routines and is rated from 0% (cannot do) to 100% (certain can do). The Cronbach's alpha for the ESES was reported to be .94 (Shin, Jang, & Pender, 2001). The Friend Support for Exercise Habits Scale/Family Support for Exercise Habits Scale (Sallis, Grossman, Pinski, Patterson, & Nader, 1987) is a 20-item scale rated from 1 (never) to 5 (very often) and measures *relatedness* toward PA&E. Only 10 of the most relevant items were used for this study. The Cronbach's alphas were high at .61–.91 (Sallis et al., 1987).

TpB instruments—*Attitudes* for PA&E (Courneya, Conner, & Rhodes, 2006) were measured by instrumental (harmful–beneficial, useless–useful, unimportant–important) and affective (unenjoyable–enjoyable, boring–fun, painful–pleasurable) scales. Items were rated from 1 (extremely) to 7 (extremely) and preceded with the following stem: 'For me, engaging in regular PA&E over the next month would be ___.' The Cronbach's alphas for attitudes ranged from .79 to .87 (Courneya et al., 2006). *Subjective norms* for PA&E (Courneya et al., 2006) were measured by injunctive (disapproving–approving, unsupportive–supportive, and discouraging–encouraging) and descriptive norms (inactive–active, disagree–agree, and low–high). Responses for each item ranged from 1 (extremely) to 7 (extremely). The Cronbach's alphas for subjective norms ranged from .84 to .90 (Courneya et al., 2006). PBC for PA&E (Courneya et al., 2006) was measured with six differential scales, including uncontrollable–controllable, untrue–true, disagree–agree, difficult–easy, unconfident–confident, uncertain–certain. Items were rated from 1 (extremely) to 7 (extremely) and preceded with: 'If you were really motivated, ___.' The Cronbach's alpha for PBC was .91 (Courneya et al., 2006). *Intentions* (Courneya et al., 2006) were rated

from 1 (extremely) to 7 (extremely) using the following items: (1) How motivated are you to engage in regular PA&E over the next month (unmotivated-motivated), (2) I strongly intend to do everything I can to engage in regular PA&E over the next month (untrue-true), and (3) How committed are you to engaging in regular PA&E over the next month (uncommitted-committed). The Cronbach's alpha was .95 (Courneya et al., 2006).

Data analysis

We conducted a secondary analysis of data collected as a part of a larger online survey for a dissertation study (Brooks, 2014). Participants completed the SDT and TpB questionnaires as a part of the survey. Canonical correlation analysis (CCA) was used and is appropriate when the purpose of the study is to explore the relationships between two multivariate sets of variables (vectors) that are all measured on the same individual. Instead of assessing the pairwise relationships among variables between the two multivariate sets of variables, CCA is a dimension reduction technique that allows us to summarize the relationships into a reduced number of statistics while preserving the main facets of the relationships.

Results

Sample characteristics

A total of 211 adults with chronic musculoskeletal pain completed the questionnaire. Participant mean age was 43 years old ($SD \pm 14.4$), and 183 (86.7%) and 188 (89.1%) participants identified themselves as female and Caucasian, respectively. Given that over half (51.2%) of the sample reported a diagnosis of fibromyalgia, a higher percentage of female participants was expected in this sample. On average, participants had been living with chronic pain for 12.9 years ($SD \pm 9.8$). On a 0–10 rating scale, pain intensity was more than moderate for the average participant ($M = 6.2$, $SD \pm 1.9$). For body mass index, 2 participants were underweight (1.1%), 64 participants (30.3%) were of normal weight, 50 (23.6%) were overweight, and 95 participants (45.0%) were obese. Participants reported, on average, spending 6.3 h ($SD \pm 6.6$) on light, moderate and/or strenuous physical activity per week.

CCA

Canonical correlation was performed between a set of SDT variables and a set of TpB variables using SPSS CANCORR. The SDT set included perceived autonomy support, autonomy, competency, and relatedness. The TpB set included attitudes, subjective norms, PBC, and intention. High scores reflected more positive beliefs about the benefits of PA&E, stronger intentions for PA&E, better autonomy support for PA&E, greater motivation and competency for PA&E, and increased social support for PA&E.

The first canonical correlation was .77 (59% overlapping variance), the second was .42 (18% overlapping variance), the third was .21 (4% overlapping variance), and the fourth was .03 (0% overlapping variance). With all four canonical correlations included, $\chi^2(16, N = 211) = 227.73$, $p < .001$, and with the first canonical correlation removed, $\chi^2(9, N = 211) = 48.17$, $p < .001$. Subsequent χ^2 tests were not statistically significant. The first two pairs of canonical variates, therefore, accounted for the most significant relationships between the

two sets of predictors for PA&E variables. Pearson's correlations among the SDT and TpB variables were all significant ($p < .05$) and mostly ranged from medium to large. The TpB factor of attitudes was correlated with the SDT factors of perceived autonomy support ($r = .22$), autonomy ($r = .55$), competency ($r = .54$), and relatedness ($r = .38$). The TpB factor of subjective norms was correlated with perceived autonomy support ($r = .41$), autonomy ($r = .17$), competency ($r = .29$), and relatedness ($r = .47$). PBC was correlated with perceived autonomy support ($r = .26$), autonomy ($r = .37$), competency ($r = .46$), and relatedness ($r = .33$). Finally, intention was correlated with perceived autonomy support ($r = .24$), autonomy ($r = .54$), competency ($r = .66$), and relatedness ($r = .37$).

Shown in Table 1 are correlations between the SDT and TpB variables and the canonical variates, canonical loadings, percent of variances (within-set variances accounted for by the canonical variates), redundancies, and canonical correlations. Total percent of variance and total redundancy indicate that the first – as well as the second pair of canonical variates – were moderately related. The first SDT variate accounts for 34% of the variance in the TpB variables, and the second SDT variate accounts for 3% of the variance. Together, the two SDT variates explain 37% of the variance in the TpB variables. The first TpB variate accounts for 28% of the variance in the SDT variables, and the second TpB variate accounts for 4% of the variance. Together, the two TpB variates explain 32% of the variance in the SDT variables. Given the nature of the variables, we named the two canonical variates: personal (P) and environmental (E) factors. While not easily disentangled, P-factors are defined as predominately psychological or inherently tied to the person such as a coping style, while E-factors are described as primarily influences external to an individual (Mpofo & Oakland, 2010). Our findings indicate that P-factor (first canonical variate) captures the strongest overlap of relationships between TpB and SDT. The E-factor (second variate) captures a modest overlap of relationship between the two theories.

Using the 'rule of thumb' cutoff correlation of .5 (Hair, Black, Babin, & Anderson, 2009), the SDT variables of autonomy, competency, and relatedness were highly associated with the first canonical variate. For the TpB set, all of the variables were highly correlated with the first canonical variate. The first pair of canonical variates indicated that low levels of competency ($-.87$), autonomy ($-.72$), and relatedness ($-.63$) were associated with low levels of intention ($-.92$), attitudes ($-.82$), PBC ($-.68$), and subjective norms ($-.58$). For the second canonical variate, low levels of perceived autonomy support ($-.63$) and relatedness ($-.52$) were related to low levels of subjective norms ($-.79$). For this sample of individuals with chronic pain, the CCA indicated that TpB variables correlate highly with SDT variables.

Discussion

This study confirmed that SDT and TpB share a similar conceptual approach to describing self-reported motivation or intentions for engagement in PA&E. Overall, the SDT set accounted for 37% of the TpB set variance and the TpB set accounted for 32% of the SDT set variance, which suggests the SDT set explains the variances in the TpB set better than the TpB's ability to account for variance in the SDT set on the two canonical variates. These results are consistent with a meta-analytic path analysis of previous studies on the relationships between integrated SDT and TpB constructs and health behavior outcomes,

with the vast majority of studies including PA&E as an outcome variable (Hagger & Chatzisarantis, 2009). The integrated model accounted for 64.6 and 58.3% of the variance in intentions and health behavior, respectively. Given the proposed motivational sequence in Hagger and Chatzisarantis's study, it is not surprising that SDT explains more of the variance in TpB variables than TpB explains for SDT in the current study.

In a related study, Chatzisarantis, Hagger, and Smith (2007) indicated that a theoretical shortcoming of SDT is that it does not explain the process by which motivational orientations transition to intentions and action states. A recent meta-analysis by Rhodes and Dickau (2012) reported that there also might be a theoretical knowledge gap between intention and behavior variables in the TpB model. They reported a medium effect size ($d = .45$) for intentions, but a small effect size for behavior ($d = .15$). Therefore, a weak relationship was demonstrated between intentions and behavior. Other research has shown that the impact of the TpB constructs is significantly reduced with the inclusion of past health behavior in the model (Bagozzi & Kimmel, 1995; Norman & Conner, 1996). These combined findings suggest that standalone theories are incomplete and that additional variables should be included in the theory to better explain health behavior change. In this study, we found that SDT constructs such as autonomy and competency are closely related to attitudes toward PA&E, perceived control, and intention in TpB. Perceived autonomy support and relatedness from SDT was also found to be similar to subjective norms from TpB. Additionally, the P-factors of autonomy and attitudes as well as competence and PBC were key factors influencing intention to engage in PA&E, while E-factors seemed to have less of a direct impact. These correlations may suggest redundancies but also directional relationships between some of the theoretical constructs, which may then lead to motivation to engage in PA&E.

There are several limitations to our study. First, our study featured a cross-sectional research design and did not actively manipulate variables. The cause-and-effect relationships, therefore, cannot be established. Second, this study used a convenience sample of volunteer participants who were self-reporting, which is subject to selection and response bias. Third, our sample was predominantly composed of Caucasian, well-educated, female adults who are familiar with computers and may not be generalizable to all people with chronic pain. Finally, brief measures were selected to minimize participant burden yet may not assess all aspects of the theoretical constructs.

Implications and future directions

The present findings provide further support that integrating SDT with TpB may help to enhance the predictive ability of the health behavior models. This is consistent with emerging integrative theoretical research that designates SDT constructs of motivation as distal predictors of health behavior, while TpB constructs of attitudes, subjective norms, and PBC are viewed as proximal predictors of intentions and behavior (Hagger et al., 2011). While TpB, in particular, has long been one of the most widely used health behavior theories (Conner, 2008; Conner & Norman, 2005), a person's intention may not be a reliable predictor variable (Schwarzer, 2008). Ajzen (1991) asserted that the TpB should be viewed

as a flexible theoretical framework for health behavior research, which means it can incorporate other constructs.

Future studies on the integration of SDT and TpB should consider incorporating concepts such as habit formation and goal content in an attempt to better explain the variance of PA&E. A complementary SDT and TpB model alone does not describe how post-motivational factors like action planning, coping planning, and habit formation influence behaviors (Arnautovska, Fleig, O'Callaghan, & Hamilton, 2016; Premeau et al., 2014). Extending the model of SDT and TpB may improve upon weaknesses of both frameworks and provide a more complete account of the motivational and social-cognitive processes that determine intentions for health behaviors (Hagger, 2009).

Conclusion

The current study provides empirical evidence that there are both similarities and boundaries between concepts from SDT and TpB related to PA&E among people living with chronic musculoskeletal pain. For assessment and practice, selecting and integrating non-redundant, complementary components from SDT and TpB theories may be an effective approach. Targeting efforts to enhance SDT and TpB beliefs may improve intentions and increase behavior change in people with chronic pain. For motivated individuals, action, coping, and maintenance plans for PA&E may also be useful. By uniting the strengths of empirically tested health behavior theories, PA&E interventions can help adults with chronic pain to decrease pain and related physical disability.

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Table 1

Correlations, standardized canonical coefficients, canonical correlations, percents of variance, and redundancies between theory of planned behavior and self-determination theory variables and their corresponding canonical variates.

	First canonical variate (personal factor)		Second canonical variate (environmental factor)	
	Canonical loading	Canonical coefficient	Canonical loading	Canonical coefficient
<i>TpB set</i>				
Attitudes	-.82	-.29	.25	.44
Subjective norms	-.58	-.29	-.79	-.98
Perceived behavioral control	-.68	-.04	-.03	-.26
Intention	-.92	-.62	.26	.42
Percent of variance	.58		.19	Total = .77
Redundancy	.28		.04	Total = .32
<i>SDT set</i>				
Perceived autonomy support	-.44	-.18	-.63	-.62
Autonomy	-.72	-.30	.48	.55
Competency	-.87	-.56	.27	.25
Relatedness	-.63	.35	-.52	-.54
Percent of variance	.47		.24	Total = .71
Redundancy	.34		.03	Total = .37
Canonical correlation	.77		.42	

Notes: First canonical variate = autonomy, competency, and relatedness, with the corresponding canonical variate from the TpB set being composed of attitudes, subjective norm, perceived behavioral control, and intention. Second canonical variate = perceived autonomy support and relatedness, with the corresponding canonical variate from the TpB set being composed of subjective norms. Bolded values indicate high levels of association.