

Prospective Results from the PA (Personality and Activity) Project: Evaluating the Influence of the Transtheoretical Model on Physical Activity while Considering Personality Trait Characteristics

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Abstract

The Transtheoretical model (TTM) consists of a framework of five discrete stages adopted to study behavior change. Previous research demonstrates utility of the TTM in influencing physical activity. Personality trait characteristics have also been shown to influence physical activity. To date, limited research has evaluated whether the TTM influences physical activity across various personality traits. This study's purpose was to examine the prospective association of each of the TTM constructs on physical activity, with considerations by personality type, using the follow-up data from the PA (Personality and Activity) Project. Personality, physical activity, TTM constructs, and covariates were assessed via validated questionnaires. 126 participants with data at baseline and the 5-month follow-up constituted our analytic sample. The only TTM construct associated with follow-up moderate-to-vigorous (MVPA) was behavioral processes of change ($\beta=10.0$; 95% CI:-0.34, 20.37; $p=0.05$). There were no significant interaction effects for any of the TTM constructs and personality types on follow-up MVPA. In conclusion, personality did not moderate the relationship between the TTM and future MVPA behavior. If confirmed by future research, these findings suggest that TTM-based physical activity interventions may not need to develop personality-matched TTM strategies.

Keywords: Personality; behavioral processes of change; exercise; TTM constructs

Öz

Kişilik ve Etkinlik Projesinin Olası Sonuçları: Değişim Aşamaları Modelinin (Transteorik Model) Fiziksel Etkinlik üzerinde Etkisinin Kişilik Özellikleri Dikkate Alınarak Değerlendirilmesi

Değişim Aşamaları Modeli (DAM) davranış değişimini incelemek amacıyla kabul edilmiş beş farklı aşamadan oluşan bir çerçeve sunar. Daha önceki çalışmalar DAM'ın fiziksel etkinliği etkilemede yararlı olduğunu göstermiştir. Kişilik özelliklerinin de fiziksel etkinliği etkilediği gösterilmiştir. Günümüze kadar DAM'ın fiziksel etkinliği farklı kişilik özelliklerinde etkileyip etkilemediği konusunda sınırlı sayıda çalışma yapılmıştır. Bu çalışmanın amacı DAM'ın her bir alt boyutunun fiziksel etkinlik ile olası ilişkisini, Kişilik ve Etkinlik Projesinden elde edilen verileri kullanarak kişilik tipine göre incelenmesidir. Kişilik, fiziksel etkinlik, DAM alt boyutları ve ortak değişkenler, geçerliliği kanıtlanmış ölçeklerle değerlendirilmiştir. Örneklem başlangıç ve 5 ay sonra takipte veri toplanan 126 kişiden oluşmaktadır. 5 ay takip ölçümünde orta-yüksek düzeyde etkinlik (OYDE) ile ilişki bulunan DAM alt boyutu değişimin davranışsal süreçleri olmuştur ($\beta = 10.0$; 95% CI: -0.34, 20.37; $P=0.05$). Bunun dışında 5 ay takipte OYDE üzerinde istatistiksel olarak anlamlı herhangi bir DAM alt boyutu ve kişilik tipi etkileşimine rastlanmamıştır. Sonuç olarak, DAM ve gelecekteki OYDE davranışları kişilik tarafından modere edilmemektedir. Sonraki çalışmalarla doğrulandığı ölçüde, bu bulgular DAM'a dayalı fiziksel etkinlik müdahalelerinin kişilikle eşleştirilmiş DAM yönergeleri geliştirmesine ihtiyaç duyulmayabileceğini göstermektedir.

Anahtar Kelimeler: Kişilik; değişimin davranışsal süreçleri; egzersiz; DAM alt boyutları

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INTRODUCTION

Despite the health-promoting benefits of physical activity, the majority of individuals still engage in low levels of physical activity (Troiano et al., 2008). Due to inadequate levels of physical activity participation, researchers have been actively seeking to identify theories to promote healthy behaviors and develop effective interventions (Choi, Chung, & Park, 2013). One important health-promoting behavior change intervention is the Transtheoretical model (TTM) (Romain, Bernard, Hokayem, Gernigon, & Avignon, 2016). The TTM consists of a framework of five discrete stages adopted to study behavior change. These stages include precontemplation, contemplation, preparation, action, and maintenance (Choi et al., 2013). Core to the TTM includes various constructs, including behavioral and cognitive processes of change, decisional balance, and self-efficacy. A vast amount of research suggests that TTM is useful in promoting physical activity behavior change (Marshall & Biddle, 2001). The TTM has been shown to be effective in promoting physical activity across various populations (Cardinal & Kosma, 2004; Cardinal, Kosma, & McCubbin, 2004).

Recently, Choi et al. suggested that psychosocial variables such as personality were related to the promotion of physical activity (Choi, et al., 2013). Individuals with greater self-efficacy are more likely to seek and utilize health-promoting behaviors such as exercise (Grembowski, et al., 1993). Additionally, the personality trait conscientiousness has been negatively correlated with unhealthy behaviors and positively related to exercise-related self-efficacy (Bogg, 2008; Bogg, & Roberts, 2004). However, the utility of the TTM in promoting physical activity behavior across varying personality traits has not been fully investigated. Evidence has demonstrated that the stages of change (e.g., precontemplation) are associated with personality traits (Choi et al., 2013). Reporting oneself as being conscientious and using avoidant-focused coping strategies, the results of the study found this personality trait (conscientiousness) to significantly differentiate between the stages of change, but did not predict later stages of behavior change. Further, evidence suggests that, in addition to self-efficacy, psychological factors including introversion, neuroticism, psychosocial stress, and social support were significantly associated with later stages of change (i.e., more consistent physical activity) (Choi, et al., 2013). However, there is a gap in the literature examining the extent to which TTM strategies (i.e., processes of change, decisional balance and self-efficacy) associate with physical activity behavior across different personality traits.

A popular personality trait model incorporates a five-part taxonomy, including neuroticism, extraversion, openness to experience/intellect, agreeableness), and conscientiousness (Rhodes & Smith, 2006). Previous research demonstrates that extraversion and conscientiousness are positively associated with physical activity. Conversely, personality traits neuroticism, openness to experience, and agreeableness either demonstrate a null or inverse association with physical activity (Rhodes & Smith, 2006).

The purpose of this study was to examine the prospective association of each of the TTM strategies on physical activity, with considerations by personality type. We hypothesize that TTM strategies (behavioral/cognitive processes of change, decisional balance and self-efficacy) will associate with physical activity, and personality type will moderate this association.

METHODS

Design and Participants

The study design was a prospective study. Procedures were approved (2015) by the authors' institutional review board, with participant consent obtained prior to data collection. Recruitment of individuals included 200 undergraduate and graduate students from a university in the South of the United States for baseline assessments. Participants were recruited via a convenience-based sampling approach. Participants did not receive any incentives to participate. When participants arrived at the laboratory, they were asked to complete an informed consent. Then, participants completed surveys assessing the TTM constructs, personality traits and physical activity. All baseline parameters were assessed via paper-and-pencil surveys. Baseline assessments occurred between June 2016 and October 2016. After approximately five months from the participant's baseline visit, all participants were reassessed. To minimize potential common method bias among the evaluated parameters (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), baseline assessments (with the exception of measured body mass index) occurred in our laboratory via a paper-and-pencil survey, whereas the follow-up participants completed the survey via an on-line portal (Qualtrics) that was sent to them via e-mail.

Among the 200 participants who were recruited, all 200 participants provided complete baseline data on the study variables (no missing values). Among these 200

participants, 126 provided complete data for the follow-up assessment (63% response rate), with these 126 participants constituting our analytic sample. Additionally, a random 10% sample from the baseline 200 participants was asked to complete a one-week test-retest reliability measure from baseline. The one-week test retest consisted of completing the surveys again for test-retest reliability purposes. The participants randomly selected for the one-week test-retest wore a pedometer for a week in an effort to assess the possible convergent validity of the self-reported physical activity assessment. When comparing (baseline estimates) the analyzed sample ($N=126$) to the sample lost to follow-up ($N=74$), there were no differences in gender ($p=0.61$), age ($p=0.72$), ethnicity ($p=0.62$), education ($p=0.07$), perceived health status ($p=0.50$), neuroticism ($p=0.64$), extraversion ($p=0.71$), openness ($p=0.95$), agreeableness ($p=0.59$), or conscientiousness ($p=0.75$). However, those lost to follow-up were less active (287.5 min/week of MVPA vs. 428 min/week of MVPA; $p=0.003$).

Measurement of Transtheoretical Model Constructs

Stage of change: To be consistent with stages of change in the TTM, regular participation in exercise was defined as “equal to five or more days per week of at least 30-minutes at a moderate intensity.” As used in previous studies, participants were asked to choose one of five statements to describe their readiness to change their exercise behavior. (Levy, Li, Cardinal, & Maddalozzo, 2009; Reed, Velicer, Prochaska, Rossi, & Marcus, 1997) The five different stages of change include precontemplation, contemplation, preparation, action, and maintenance. For example, participants who reported, “No, I do not plan to start in the next six months” were classified in the precontemplation stage. The stage of change algorithm has demonstrated evidence of reliability and validity in adults of the general population and those with chronic diseases (Levy et al., 2009; Reed et al., 1997). In the present sample, the one-week test-retest reliability was, $ICC=0.64$.

Processes of change: To examine the strategies individuals use to change their exercise behaviors, a 30-item measure was used to assess both behavioral and cognitive processes of change. Fifteen items assessed behavioral process of change (BPC) (i.e., reinforcement management, counter-conditioning, helping relationships, self-liberation, and stimulus control), whereas the other 15-items assessed cognitive processes of change (CPC) (i.e., consciousness

raising, dramatic relief, environmental reevaluation, self-reevaluation, and social liberation). Participants were asked to respond to each question using a Likert scale, with end points ranging from 1 (never) to 5 (repeatedly). A sample BPC item is “Instead of relaxing by watching TV or eating, I take a walk or do physical activity.” A sample cognitive process of change question is “I believe that regular physical activity will make me a healthier, happier person.” Reliability and validity of both the behavioral and cognitive process of change have been previously established. (Nigg, & Riebe, 2002) Behavioral and cognitive processes of change were calculated by summing the items for each process of change separately. Higher scores indicate higher use of behavioral processes or cognitive processes of change. In the present sample, the one-week test-retest reliability for BPC and CPC, respectively, were, $ICC=0.90$, $ICC=0.91$. Further, internal consistency in the present sample, as measured by Cronbach’s alpha, for BPC and CPC, respectively, were, $\alpha=0.89$, $\alpha=0.83$.

Self-efficacy: To assess self-efficacy, or an individual’s confidence in ability to overcome barriers, an 18-item measure, which has demonstrated evidence of reliability and validity, was used (Levy & Ebbeck, 2005; Marcus, Eaton, & Rossi, 1994). For each question, participants responded using a Likert scale, with end points ranging from 1 (not at all confident) to 5 (very confident). A sample item is “I feel confident that I can participate in physical activity when I don’t feel like it.” Items were summed, with higher scores indicating higher self-efficacy. In the present sample, the one-week test-retest reliability for self-efficacy was, $ICC=0.82$. Further, internal consistency in the present sample, as measured by Cronbach’s alpha, was, $\alpha=0.92$.

Decisional balance: An individual’s reflection of the pros and cons in engaging in regular physical activity, referred to as decisional balance, was evaluated using a 10-item measure. Five items assessed pros of regular exercise, whereas the other five items evaluated the cons of engaging in regular exercise. Using a Likert scale anchored by 1 (not at all) and 5 (very much), participants were asked to rate their degree of agreement with each perceived positive and negative consequence of exercise involvement. A sample item of pros for exercise is “Physical activity would help me reduce tension or manage stress.” A sample item of cons for exercise is “Physical activity would take too much of my time.” This measure has previously demonstrated evidence of reliability and validity (Plotnikoff et al.,

2001). Pros and cons were scored separately by summing the respective items, with a higher pros score indicating more perceived pros of exercise and a lower cons score indicating fewer perceived cons of exercise. In the present sample, the one-week test-retest reliability for pros and cons, respectively, were, $ICC=0.93$, $ICC=0.63$. Further, internal consistency in the present sample, as measured by Cronbach's alpha, for pros and cons, respectively, were, $\alpha=0.85$, $\alpha=0.72$.

Measurement of Personality

In order to assess personality, the Neuroticism-Extraversion-Openness Five Factor Inventory (NEO-FFI) questionnaire was used. The NEO is a five factor inventory scale. The inventory consists of five 12-item scales (60 items total) that measure each domain of five factors (Neuroticism, Extroversion, Openness, Agreeableness, Conscientiousness). There are 60 statements that describe people in a general way. A sample item from the NEO questionnaire that assesses Conscientiousness is "I keep my belongings clean and neat;" A sample item assessing Extroversion is "I like to have a lot of people around me;" A sample item assessing Openness is "I am intrigued by the patterns I find in art and nature;" A sample item assessing Neuroticism is "When I'm under a great deal of stress, sometimes I feel like I'm going to pieces;" and lastly, a sample item for Agreeableness is "I would rather cooperate with others than compete with them." Response options range from zero to four, with zero being strongly disagree and four being strongly agree. Response option two stands for neutral. The NEO-FFI provides a quick, reliable, and accurate measure of the five domains of adult (ages 17 years and older) personality (Costa, & McCrae, 1992). Internal consistency, as measured by Cronbach's alpha, was 0.85 (neuroticism), 0.75 (extraversion), 0.75 (openness), 0.76 (agreeableness), and 0.84 (conscientiousness). The test-retest reliability assessment of the 10% random sample was 0.92 (neuroticism), 0.95 (extroversion), 0.93 (openness), 0.98 (agreeableness), and 0.96 (conscientiousness).

Physical Activity Behavior

Physical activity was assessed using the International Physical Activity Questionnaire (IPAQ). The IPAQ form asked participants about the time they spend being physically active in the last seven days. For example, a question on the form is "How much time did

you usually spend on one of those days doing vigorous physical activities in the garden or yard?" Participants can report their answer in hours per day or minutes. Previous research shows the IPAQ to demonstrate some evidence of being reliable and valid. (Craig et al., 2003) Meeting moderate-to-vigorous physical activity (MVPA) guidelines was defined as at least 150 minutes/week. Among the 10% random sample of the present study, the correlation between IPAQ-determined MVPA and pedometer-determined steps was, $r=0.43$ ($P<0.001$). The one-week test-retest reliability (for IPAQ) of our 10% random sample was, $ICC=0.79$.

Data Analysis

All analyses were performed in Stata (v. 12). Multivariable linear regression analyses were used to assess the association between baseline TTM constructs with 5-month follow-up MVPA. A single model was evaluated that included each of the following covariates: baseline MVPA, each of the five personality types, age, gender, race-ethnicity, perceived health status (excellent, very good, good, fair, or poor), measured body mass index (kg/m^2) and duration of follow-up (months). There was no evidence of multicollinearity (e.g., highest individual variance inflation factor was 2.6) in this model. Additionally, potential multiplicative interaction effects for each of the TTM constructs and each personality trait on follow-up MVPA were evaluated by creating a cross-product term of the individual TTM construct and the individual personality trait, and including this term along with the main effects and covariates, in the model. Statistical significance for all models was set at an alpha level of $P<0.05$.

RESULTS

Table 1 displays the characteristics of the analyzed sample. Table 2 displays the multivariable linear regression results evaluating the association between the TTM constructs and 5-month follow-up MVPA. Results showed that, after adjustments, the only TTM construct associated with follow-up MVPA was behavioral processes of change ($\beta=10.0$; 95% CI:-0.34, 20.37; $p=0.05$). Although not shown in tabular format, we also evaluated potential interaction effects of each of the TTM constructs on each of the personality traits on follow-up MVPA. Notably, there were no significant interaction effects for any of the interaction models (all P 's >0.05).

Table 1: Characteristics of the study sample (N=126).

<i>Study Variable</i>	<i>Mean/Proportion</i>	<i>Standard Deviation</i>
Age, mean years	21.6	2.33
Gender, % female	61.9	
Education, % undergraduate students	81	
Ethnicity, % non-Hispanic white	66	
BMI, mean kg/m ²	25.85	6.91
Health Status, %		
Excellent	16.67	
Very good	47.62	
Good	30.95	
Fair/poor	4.76	
MVPA at baseline, mean min/week	428.1	353
MVPA at 5-month follow-up, mean min/week	571.5	408
Follow-up duration, mean days	159.6	24.4
Personality		
Neuroticism, mean	30.9	8.6
Extraversion, mean	43.3	5.9
Openness, mean	39.0	6.7
Agreeableness, mean	45.7	6.3
Conscientiousness, mean	46.9	6.4
Transtheoretical Model Constructs		
Self-efficacy, mean	66.9	13.1
Pros, mean	22.1	3.0
Cons, mean	8.1	3.1
Cognitive processes of change, mean	57.4	8.2
Behavioral processes of change, mean	56.3	9.9
Stage of Change, %		
Maintenance	63.5	
Action	18.3	
Preparation	16.7	
Contemplation	1.6	
Pre-contemplation	0	
BMI body mass index MVPA, moderate-to-vigorous physical activity		

Table 2: Multivariable linear regression evaluating the association between the TTM constructs and 5-month follow-up moderate-to-vigorous physical activity (N=126).

<i>Personality Trait</i>	β	<i>95% CI</i>	<i>P-Value</i>
Cognitive processes of change, 1 unit increase	-1.31	-14.1, 11.15	0.84
Behavioral processes of change, 1 unit increase	10.0	-0.34, 20.37	0.05
Pros, 1 unit increase	-28.6	-64.2, 6.9	0.11
Cons, 1 unit increase	-9.5	-35.1, 16.0	0.45
Self-efficacy, 1 unit increase	2.7	-4.5, 10.0	0.45
A single multivariable linear regression analysis was employed that included the above-noted TTM constructs and the following covariates: baseline MVPA, each of the five personality types, age, gender, race-ethnicity, education, perceived health status (excellent, very good, good, fair, or poor), measured body mass index (kg/m ²) and duration of follow-up (months). BMI, Body mass index, MVPA, Moderate-to-vigorous physical activity			

DISCUSSION

Previous work demonstrates that personality type may influence physical activity behavior. Similarly, repeated research demonstrates that the TTM may have utility in influencing physical activity behavior. This study aimed to evaluate both of these models to see if personality type moderated the relationship between TTM on physical activity. Our results did not demonstrate any potential interaction effects of TTM and personality type on physical activity.

Due to low levels of physical activity (Troiano et al., 2008), behavior change strategies are important to identify, develop and implement in physical activity-based interventions (Bauman et al., 2012; Vo & Bogg, 2015). One approach that has attempted to explain when and how people are likely to change their exercise behavior is through the use of the TTM (Prochaska & DiClemente, 1983). Individual differences in personality may influence the use of the TTM when promoting physical activity. For example, high neuroticism or low conscientiousness have been identified as a negative predictor of self-efficacy and low physical activity (Axelsson, Lotvall, Cliffordson, Lundgren, & Brink, 2013). Perhaps, utilizing the TTM to improve self-efficacy among highly neurotic or less conscientious individuals will in turn increase physical activity levels. Additionally, the TTM construct of the cognitive processes of change, consciousness-raising, may be useful in individuals with low conscientiousness to promote physical activity (Bogg, 2008). Consciousness-raising includes efforts to acquire information and a better understanding of a specific behavior, in this case physical activity. It is plausible to suggest that understanding the benefits of physical activity will increase overall physical activity levels. However, there is limited prospective data on the potential moderational effects of personality on the relationship between the TTM constructs and physical activity (de Vries, Truong, & Evers, 2016). This study sought to explore this specific gap in the literature.

The TTM construct processes of change include strategies used to change one's behavior and processes through the stages of change (Romain et al., 2016). Behavioral processes of change consists of five processes (i.e., helping relationships, counterconditioning, reinforcement management, stimulus control, social liberation) (Prochaska, 2008). Helping relationships refers to social support, counterconditioning refers to substituting the problematic behavior, reinforcement management refers to self-reward

for change, stimulus control refers to removing cues for unhealthy habits, and social liberation refers to commitment to change. Behavioral processes of change have been hypothesized to increase in a linear fashion up to the action stage of the TTM and then level off during the maintenance stage (Marshall & Biddle, 2001; Romain et al., 2014). In the present study, the only TTM construct associated with follow-up MVPA was behavioral processes of change. It is plausible to suggest that only behavioral processes of change was associated with follow-up MVPA because behavioral processes of change tend to be used more in the later stages of change. Therefore, since our sample was a relatively active sample, this could explain why this TTM strategy emerged as a predictor of MVPA.

The present study also evaluated potential interaction effects of each of the TTM constructs on each of the personality traits on follow-up MVPA. Notably, there were no significant interaction effects for any of the interaction models. Therefore, in our sample, this suggests that personality did not play a moderational role. We anticipated that certain personality traits, such as neuroticism, would moderate the relationship between the TTM and MVPA. Although speculative, our null interaction findings may be driven by our highly active sample. It seems plausible that in a sample with greater variability in MVPA behavior (inactive to active participants), personality may alter the association between the TTM constructs and future MVPA. As an example, a highly neurotic individual in the contemplation or preparation behavioral stage with intent to become more active in the future may be less likely to indeed become active in the future, even if they have sufficient pros and self-efficacy, because of the potential offsetting anxiety effects of neuroticism. Future research should continue to explore this topic using a more diverse sample with regard to physical activity behavior.

With the population consisting of strictly college students, in a Southern part of the United States, a limitation of this study is the limited generalizability to other populations. Further, the health behavior physical activity was assessed via self-report and are therefore subject to limitations such as recall and social desirability bias. Additionally, all measures were assessed using a survey, which may be subject to common method bias (Wingate, Sng, & Loprinzi, 2018). Another limitation is the selective attrition of students with lower levels of physical activity. Further, because of logistical limitations, we completed the follow-up assessments at an approximate 5-month period, as opposed

6-months or longer. Notable strengths of this study include the study's novelty, employment of a prospective study design and incorporating a test-retest subsample (inclusive of pedometer assessment).

In conclusion, the only TTM construct associated with follow-up MVPA was behavioral processes of change. Personality did not appear to play a moderational role regarding the relationship between the TTM and MVPA. Future research would benefit by overcoming our study limitations as well as investigating lower-order personality traits (type A personality) on changes in physical activity behavior and utility of TTM constructs.

Conflict of Interest

No conflict of interest was declared by the authors.

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No financial disclosure was received

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