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ORIGINAL PAPER

Development of the Impact of Physical Activity Scale

Tracy Packiam Alloway[1] · **Ryan Parker**[1] · **Brian Cohen**[1]

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Abstract
Despite evidence that exercise has physical and mental benefits, there is still a high dropout rate. One reason for why people struggle to maintain consistency in their workout programs is self-efficacy, the cognitive mechanism that predicts behavioral intention. Given that emotional arousal plays an important role in self-efficacy, we developed the Impact of Physical Activity (IPA) scale to investigate how positive and negative affect influence commitment to exercise. The findings demonstrate good internal reliability of the scale, as well as convergent and divergent validity with optimism and depression. The IPA also had good predictive validity of physical self-efficacy.

Keywords Self-efficacy · Exercise · Emotional arousal · Working memory · Depression

Introduction

Despite the many reasons to start an exercise regimen, ranging from a newfound social interaction, the benefit of a healthy physical body and better mental functioning, there is still diminished consistency in engaging in exercise. People often have intentions to change their lifestyles and behaviors, but fall short in accomplishing these goals. Despite substantial evidence that exercise has multiple physical and mental benefits, there is still a high dropout rate. Less than 5% of adults participate in 30 min of physical activity each day and only one in three adults receive the recommended amount of physical activity each week (U.S. Department of Health). More than 80% of adults do not meet the guidelines for both aerobic and muscle-strengthening activities, and more than 80% of adolescents do not do enough aerobic physical activity to meet the guidelines for youth (U.S. Department of Health and Human Services).

Although there are many possible reasons why people struggle to maintain consistency in their workout programs, such as lack of perseverance, time, energy, or emotional support, self-efficacy is one of the key cognitive mechanisms that predicts behavioral intention (Bandura and Adams 1977). Self-efficacy, a person's level of confidence in their ability to complete a set of behaviors, as an impetus for change is widely supported in the field of sports psychology as well (see McAuley 2011 for a review). Sniehotta et al. (2005) found that self-efficacy and outcome expectancies were the most influential predictors of behavioral intentions with regards to physical exercise (see also Neupert et al. 2009, for similar findings with older adults).

When considering self-efficacy in the context of exercise as a habit, one factor of interest is emotional arousal and the perceived impact of exercise on the individual's mental state. For example, Kavanagh and Bower (1985) found that emotional arousal impacted self-efficacy in a range of domains, including athletic performance. When participants were asked to recall a positive memory of an event, they had higher self-efficacy scores, even in the athletic domain (example: "lose 6 lb in 2 weeks and retain the loss for 6 months"). One explanation for why efficacy is influenced by emotional arousal is based on the idea that salient emotions are strongly connected to an event, which is subsequently stored in long-term memory. When faced with a similar situation, the associated emotion is also retrieved, which strengthens resolve to act. Given the influence of emotional arousal in self-efficacy, it is important to consider the impact of positive and negative emotions in the context of physical activity, especially in light of the lack of consistency in engaging in exercise. Thus, the aim of the present study was to develop and examine the reliability and validity of a scale measuring the perceived impact of exercise. In order to measure concurrent validity, statements about

✉ Tracy Packiam Alloway
t.alloway@unf.edu

[1] Department of Psychology, University of North Florida, 1 UNF Drive, Jacksonville, FL 32224, USA

physical self-efficacy were included. In addition, based on the substantial research on the benefits of actual exercise on mental health (see Wegner et al. 2014, for a meta-analysis), such as depression (Lawlor and Hopker 2001, also Choi et al. 2019 for exercise as a preventative strategy against depression) and optimism (Kavussanu and McAuley 1995), measures of these were included to explore convergent and discriminant validity of the scale.

Method

Participants

A total of 276 participants (17% male) participated in the study in exchange for course credit. The majority of participants (96%) were under 30 years (27% were 18 to 19 years old; 60.5% 20 to 25 years old; 8.3% 26 to 30 years old). With respect to their regular physical activity, 68% reported participating in aerobic/cardio activities (running, swimming, Zumba); 44% balance/flexibility training (yoga, Pilates, stretching); 31.5% resistance training (weight lifting, cross training, bodybuilding, and powerlifting). Ethical approval for this study was granted by the University governing body.

Materials

Impact of Physical Activity Scale (IPA)

There were 17 items created to assess the impact of physical activity on a four-point scale (strongly disagree–strongly agree). Questions explored positive and negative moodes relating to exercising. Sample questions include "I have a more positive mindset after I participate in physical activity", and "I feel like my life will never get better if I do not change my exercise habits."

Physical Self-Efficacy

Two items measured confidence in terms of continuing to workout at a good rate and not quitting on a four-point scale ranging from not confident to highly confident. An example statement was, "I am able to continue to exercise three times per week at moderate intensity, for 40 or more minutes without quitting for the next 2 or 4 weeks."

Dispositional Optimism

We administered the Life Orientation Test-Revised (LOT-R; Scheier et al. 1994), which consists of optimism and pessimism subscales (three items each, plus four filler items). Each statement is rated on a 5-point scale with 1 = *I agree a lot* and 5 = *I disagree a lot*). The pessimism items were reverse scored. The optimism and pessimism scores were summed separately. The reported Cronbach's α is .82 (Scheier et al. 1994).

Depression

Twenty questions from the Centre for Epidemiological Studies Depression Scale (CES-D, Radloff 1977) were used to measure depressive symptoms, as defined by the Diagnostic and Statistical Manual for a major depressive episode. Participants rate statements depending on how strongly they felt the statements applied to them during the past week on a four-point scale (rarely—most or all of the time). Some statements referred to negative feelings (e.g., "I was bothered by things that don't usually bother me"), while others referred to more positive feelings (e.g., "I felt hopeful about the future"). Higher scores are associated with higher levels of depression (max score = 20), and any score of 16 or higher is considered depressed. The CES-D has been found to have excellent reliability, with an internal consistency of Cronbach's α ranging from 0.88 to 0.91 and test–retest reliability of 0.87 (Miller et al. 2008).

Working Memory

This cognitive skill was measured using a modified version of Backward Digit Recall taken from a standardized assessment, the Automated Working Memory Assessment (Alloway 2007). The individual recalls a sequence of spoken digits in the reverse order. The test begins with recalling two numbers in backward order and is increased by one item in each block, up till nine numbers per block. There were two trials in each block and the number stimuli were different for each testing sessions. Scoring was calculated based on the highest block where they correctly recalled one of the two trials (span score). Test–retest reliability was .86 in a normative sample (Alloway 2007); and convergent validity was established in Alloway et al. (2009).

Procedure

The study was advertised on the university research participation system and volunteers were recruited over a six-month period. The criteria for participation was English was their first language. Individuals who chose to participate clicked on a link hosted by a third-party website, Qualtrics.

Results

Reliability of the IPA

In order to investigate the factor structure of the *Impact of Physical Activity* scale, an exploratory factor analysis was

conducted on the raw scores for all 17 items, rotated to final solution with a Varimax rotation. Four factors emerged with eigenvalues in excess of 1.00, accounting for a total of 65.80% of the variance (see Table 1). Factor 1 appears to tap positive emotions associated with physical activity (37.8% of variance), whereas Factor 2 corresponds to negative moods from lack of physical activity (13.92% of variance). Factor 3 refers to motivation for exercising (8.02% of variance), however Factor 4 comprised of one unique item (6.06% of variance; *The way I look gives me positive external feedback*). As this item did not load on any other factor, we removed it from subsequent analyses.

The Cronbach's alpha for all items for the IPA scale (except for the statement *The way I look gives me positive external feedback*) was .87, and the split = half coefficient was .79, indicating good internal reliability of the scale. Based on the EFA, subscale scores were created for Positive Impact, Negative Impact, and Motivation. Cronbach's alpha values for the subscales were as follows: Positive Impact (.90), Negative Impact (.81), and Motivation (.70).

Validity of the IPA

The IPA scores were positively correlated with optimism (r = .30) and pessimism (r = .20); and negatively correlated with depression (r = − .21; see Table 2). Depression and optimism levels were both negatively correlated (r = − .19). This pattern suggests that the impact of physical activity was related to optimism, pessimism, and depressive symptoms. However, the relationship between the IPA and working memory was not significant, suggesting the emotional arousal resulting from physical activity was not linked to a cognitive performance.

In order to evaluate whether the IPA scale was a good predictor of physical self-efficacy, we conducted two stepwise regression analyses. The first was the physical self-efficacy at 2 weeks, with the statement "I am able to continue to exercise three times per week at moderate intensity, for 40 or more minutes without quitting for the next 2 weeks" as the outcome variable. The predictor variables were scores for the working memory span, optimism, pessimism depressive symptoms, and the IPA score. Both the IPA and pessimism scores predicted physical self-efficacy at 2 weeks (see Table 3). The stepwise regression analysis for physical self-efficacy at 4 weeks indicated that only the IPA scale was a significant predictor.

Table 2 Correlations between measures

	WM	Optimism	Pessimism	IPA	Depression
Working memory	1				
Optimism	.07	1			
Pessimism	.01	.53**	1		
Impact of Physical Activity scale	.06	.31**	.21**	1	
Depression	− .10	− .35**	− .35**	− .20**	1

WM working memory

Table 1 Factor loadings of the items from the Impact of Physical Activity scale

	Factor			
	1	2	3	4
I feel more energized after participating in physical activity	.836			
I have a more positive mindset after participating in physical activity	.806			
I like the way I feel after I participate in physical activities	.799			
I get pleasure out of participating in physical activity	.748			
After participating in my daily activity I carry myself in a more positive manner	.730			
I usually enjoy participating in physical activities	.681			
It is hard for me to fall asleep nightly if I miss my daily physical activity		.815		
I am in a bad mood when I miss my physical activities		.784		
I find myself getting angry easily when I am not consistent with my daily physical activities		.778		
I have a low energy drive when I am not consistent with my weekly workout routine	.476	.548		
I actively participate in sporting activities because it keeps me motivated		.477	.426	
I lack confidence about myself while performing physical activities around others			.724	
I do not have the desire to leave my house to participate in physical activity			.684	
I find it easy to motivate myself to participate in physical activities			.666	
I feel like my life will never get better if I do not change my exercise habits			.655	
The way I look gives me positive external feedback				.748
I feel fine when I do not participate in physical activities		.485		− .560

In order to investigate which subscale of the IPA (Positive, Negative, or Motivation) could uniquely identify physical self-efficacy at 4 weeks, we divided the sample into two groups based on their confidence ratings on whether they would be able to continue exercising three times per week without quitting: not confident (n = 49) and highly confident (n = 68). We conducted a discriminant function analysis (DFA) with the three subscale scores from the IPA, entered in a stepwise method. The three subscales were significant in assigning classification for 92.35% of the sample: 91.8% of non-confident individuals and 92.6% of highly confident participants; χ^2 (3) = 116.23, p < .001. This outcome establishes all three subscales of the IPA were important predictors of physical self-efficacy.

Discussion

The aim of the present study was to develop the Impact of Physical Activity (IPA) scale to investigate how positive and negative emotions influence commitment to exercise. The findings demonstrated that the items clustered around three subscales relating to positive and negative emotions and motivation. One statement did not load on the other factors and was subsequently eliminated. There was good internal reliability of the scale as a whole, as well as the three individual subscales.

Consistent with our expectations of convergent validity, the IPA was positively correlated with optimism and negatively correlated with depression. This pattern extends previous research on the link between exercise, optimism, and depression and suggests that the emotions associated with exercise, and not just exercise per se, are also correlated with mental health. When people feel positively about exercising, this emotion was associated with an optimistic outlook. Conversely, negative moods associated with a lack of exercise were related to a pessimistic outlook and depressive tendencies.

Divergent validity was demonstrated as a non-significant correlation between the IPA and working memory. This pattern suggests that positive and negative emotions associated with exercising is not related to a more cognitive process, tapped by the working memory test. This finding has implications for how intentions are formed towards behavior as emotional arousal appear to be a more salient factor with respect to maintaining an exercise program.

The IPA also had good predictive validity of physical self-efficacy. The regression analyses demonstrated that IPA scores predicted the participants' commitment to exercising regularly at both the two- and four-week time frame. It is interesting to note that emotional arousal associated with exercising was a stronger predictor of self-efficacy than optimism, pessimism, or depressive symptoms. All three subscales (positive and negative emotions, and motivation) were significant predictors of participants' confidence ratings on whether they would be able to continue exercising three times per week without quitting. This pattern may be due to a selective memory bias, where emotional arousal biases future decisions (see Kavanagh and Bower 1985).

There are some limitations to the present study. The population in the present study was a convenience sample of university students, and thus the age was restricted to those under 30 years. However, there are reported age differences in self-efficacy, where older adults tend to attribute that outcomes can be achieved following the advice of an expert, rather than self-directed behavior (see Lachman and Leff 1989). In light of existing research on the benefit of self-efficacy in the maintenance of an exercise program for older adults (Neupert et al. 2009), it is worth exploring the reliability and validity of the scale in different age groups. In addition, optimism levels differ as a function of age (see Alloway and Horton 2016), thus the link between self-efficacy, optimism, and mental health may differ from that reported in the present study.

In conclusion, the IPA scale can offer fitness professionals, coaches, and personal trainers insight into how likely their clients will commit to maintaining an exercise program. As emotional arousal makes it more likely that people will retrieve the relevant information to exercise, coaches can use this feedback to strength their client's resolve and bridge the intention-behavior gap.

In addition, the individual can also use knowledge of their own positive and negative moods to direct their physical self-efficacy, and improve mental health outcomes. There is substantial evidence to support this view. For example, a large cross-sectional study of data from 1.2 million people in the USA confirmed a positive association between exercise and mental health and the authors suggested that physical

Table 3 Correlations between measures

	R^2 change	F	β	t
Outcome: physical self-efficacy (2 weeks)				
Impact of Physical Activity scale	.440	181.63*	.64	12.90*
Pessimism	.014	5.86*	.12	2.42*
Outcome: physical self-efficacy (4 weeks)				
Impact of Physical Activity scale	.446	186.15*	.67	13.64*

exercise is significantly associated with self-reported mental health (Chekroud et al. 2018). Thus, the use of the scale in the present study to encourage self-efficacy in exercise can provide a useful first step in better mental health outcomes.

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