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Acute Affective Response to a Moderate-intensity Exercise Stimulus Predicts Physical Activity Participation 6 and 12 Months Later

David M. Williams, **Shira Dunsiger**, **Joseph T. Ciccolo**, **Beth A. Lewis**, **Anna E. Albrecht**, and **Bess H. Marcus**

Participation in regular physical activity is associated with a lower risk of several chronic diseases (Knowler et al., 2002; McTiernan et al., 2003; Slattery & Potter, 2002; Thompson et al., 2003; Vuori, 2001) and all cause mortality (Lee & Skerrett, 2001; Mokdad et al., 2004). Yet, only 45% of U.S. adults currently engage in the recommended level of physical activity (Macera et al., 2005), thus highlighting the need to identify determinants of physical activity adoption and maintenance (Baranowski, Anderson, & Carmack, 1998; Lewis, Marcus, Pate, & Dunn, 2002). Physical activity research has generally been based on one or more socio-cognitive models (Ajzen, 1991; Bandura, 1986; Rogers, 1983) or models that incorporate multiple constructs from various theories (Prochaska & DiClemente, 1984). Consistent with these models, a majority of research on physical activity determinants has focused on cognitive, behavioral, and more recently, environmental variables (e.g., Humpel, Owen, & Leslie, 2002; Trost, Owen, Bauman, Sallis, & Brown, 2002). Some of these models also include affective states as predictors of behavior (e.g., Bandura, 1986); however, little is known regarding how affective variables relate to physical activity participation.

Hedonic theory (Kahneman, 1999; Young, 1952), a derivative of learning theory (e.g., Thorndike, 1927), provides a framework for understanding relationships between affect and physical activity behavior. While behaviorist notions of learning focus on observable and instrumental consequences of behavior (Skinner, 1938; Watson, 1919), hedonic theory focuses on affective responses to behavior as determinants of future behavior (Kahneman, 1999; Young, 1949). Cabanac (1971, 1992) has argued that hedonic responses (i.e., pleasure versus displeasure) provide an index of the usefulness of behavior and its immediate outcomes relative to existing internal states. For example, Kahneman, Fredrickson, Schreiber, and Redelmeier (1993) have shown that affective responses to a behavior may influence decisions regarding whether or not to repeat the behavior. This tendency for humans to maximize pleasure and minimize displeasure has been examined extensively as a mechanism for eating behavior (for reviews see Cota, Tschöp, Horvath, & Levine, 2006; Nasser, 2001), and has recently been posited in the context of exercise behavior (Cabanac, 2006; Ekkekakis, Hall, & Petruzzello, 2005). Consistent with hedonic theory, the purpose of this paper is to examine acute affective responses to exercise behavior as a predictor of future physical activity participation.

CORRESPONDING AUTHOR: David M. Williams, Ph.D., Brown Medical School and The Miriam Hospital, Centers for Behavioral and Preventive Medicine, Coro Bldg., Suite 500, One Hoppin Street, Providence, RI 02903, dwilliams2@lifespan.org Phone: 401-793-8195, Fax: 401-793-8056.

When considering the relationship between affect and physical activity, it is important to first distinguish among affect-related terms. In this paper we distinguish between *basic affect* and *distinct affective states.* Consistent with Ekkekakis and Petruzzello's (2000) review of the use of affect-related terminology, we consider *basic affect* to be the most general valenced experiential response (i.e., good/pleasure versus bad/displeasure). *Distinct affective states*, such as emotions and moods, include this basic affective component (i.e., good/pleasure versus bad/displeasure), plus a cognitive appraisal process (for a discussion of differences between emotions and moods see Ekkekakis & Petruzzello, 2000; Larsen, 2000). Thus, basic affect (i.e., good/pleasure versus bad/displeasure) can occur in the absence of an appraisal process and thus outside the context of more distinct affective states, or, can underlie a distinct affective state. For example, anger and embarrassment are distinct affective states, which include an underlying basic affective response (i.e., bad/displeasure), as well as an appraisal process. Finally, we use the term *affect* as an umbrella term encompassing both basic affect and distinct affective states.

A significant body of research has examined changes in both distinct affective states (Berger & Motl, 2000; Gauvin & Rejeski, 1993; McAuley & Courneya, 1994), and, more recently, basic affect (Ekkekakis et al., 2005) in response to acute bouts of exercise. However, few studies have examined the link between affective response to exercise and future physical activity. (Annesi 2002a, 2002b, 2005) conducted a series of studies examining relationships between affective responses prior to and following acute exercise bouts and attendance at an exercise facility among 69, 72, and 50 (respectively) healthy, previously sedentary adults. Participants were asked to complete 20–30-min moderate to vigorous intensity exercise sessions 3 times per week over a 12–15 week period and to complete the Exercise-induced Feeling Inventory EFI; (Gauvin & Rejeski, 1993) biweekly before and 5–10 min after the exercise session. The EFI assesses 4 distinct affective states, including positive engagement, revitalization, tranquility, and physical exhaustion. In each of the studies, differences in pre-post scores for each subscale were aggregated over time, and used to predict attendance at the exercise facility during the 15-week program period. There was no main effect of EFI responses to exercise in two of the studies (Annesi, 2002a, 2002b); however, in one of these studies there was an interaction between EFI responses and baseline self-motivation. Specifically, among participants with low self-motivation there were positive relationships between positive engagement, revitalization, and tranquility subscales and exercise attendance, and a negative relationship between the physical exhaustion subscale and exercise attendance, but these relationships were opposite among participants with high self-motivation (Annesi, 2002a). In the third study (Annesi, 2005), conducted only among women, exercise attendance was positively related to revitalization and negatively related to exhaustion. The other two subscales of the EFI were not administered.

Berger and Owen (1992) used a similar design to examine distinct affective responses to exercise, as measured by the state scale of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) and the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971), as predictors of class attendance among 59 college students enrolled in either swimming or yoga classes. The STAI and POMS, which includes subscales for 6 mood states, were taken before and after three exercise classes at the beginning, middle, and end of the 14-week semester. Aggregated change scores for the STAI and each subscale of the POMS accounted for approximately 25% of the variance in classroom attendance when entered together in multivariate analysis. Although results for individual scales were not presented, the authors stated that “exercisers who reported greater mood benefits had fewer absences” (p. 1340).

Two additional studies measured affective states before and after a baseline exercise session. (Klonoff, Annechild, and Landrine (1994)) assessed levels of happiness and euphoria via single-item Likert scales administered prior to and following a 30-min aerobics session among 23 healthy, previously inactive women. Change scores for the two scales were found to be unrelated to number of aerobics sessions completed during a subsequent 10-week aerobics program. Similarly, Carels, Berger, and Darby (2006) assessed mood states via the POMS before and after a graded submaximal exercise test completed at baseline of a 24-week behavioral weight-loss program among 25 previously sedentary, obese, postmenopausal women. No relationship was found between change scores for each POMS subscale and subsequent exercise; however, scores from the subscales vigor-activity, depression-dejection, and anger-hostility taken after the baseline exercise test were positively related to one or more measures of subsequent physical activity, while negative relationships were found for fatigue-inertia and confusion-bewilderment.

Taken together, the findings from previous studies examining the relationship between affective response to acute exercise and future physical activity behavior have been inconsistent and difficult to characterize. While the studies reviewed are among the first to examine this issue, the mixed findings may be attributed to a number of conceptual and methodological weaknesses. First, all of the studies reviewed measured distinct affective states rather than basic affect. When examining the relationship between affective responses to acute exercise and future physical activity participation, there are a number of reasons to prefer basic affect over distinct affective states at the present stage of knowledge development. For example, distinct affective states, such as tranquility, tension, or confusion-bewilderment do not lend themselves to any clear hypotheses concerning the relationship between affect and future behavior. Alternatively, consistent with hedonic theory (Kahneman, 1999; Young, 1952), differences in positive-negative valence of basic affective responses to exercise among previously sedentary individuals may serve to reinforce or punish the behavior and in turn make future physical activity participation more or less likely. Moreover, as pointed out by Ekkekakis and Petruzzello (2000), it is not clear which distinct affective states would have the greatest influence on subsequent physical activity, and since not all distinct affective states can be measured at one time, there would be a risk of failing to measure one or more crucial affective states.

Second, due to the multi-item nature of measures of distinct affective states (e.g., Gauvin & Rejeski, 1993), assessments were administered prior to and following, but not during the exercise task; thus, these studies measured the affective response to *completing* the bout of exercise, rather than the affective response *during* exercise (Ekkekakis & Petruzzello, 1999; Hall, Ekkekakis, & Petruzzello, 2002). As a result, studies, such as these, assessing affective responses before and after but not during exercise support the conclusion that acute bouts of exercise uniformly improve affective states (Yeung, 1996), while studies that have measured affective response during exercise (e.g., Feeling Scale; Rejeski, Best, Griffith, & Kenney, 1987) have shown significant interindividual variability in acute affective responses during moderateintensity exercise (e.g., brisk walking; Ekkekakis, Hall, Van Landuyt, & Petruzzello, 2000), leaving open the possibility that this variable affective response may predict future physical activity participation (Ekkekakis, Hall, & Petruzzello, 2004).

Third, these studies exhibited a number of methodological and/or analytical problems involving timing of assessments and lack of control for potential confounders. Although all of the studies were longitudinal, in some studies (Annesi, 2002a, 2002b, 2005; Berger & Owen, 1992), the measurement of affect temporally overlapped with the measurement of physical activity participation, making the possibility of confounding more likely. That is, a third variable, such as a favorable social atmosphere, may have caused both positive affective responses and increased exercise participation. Moreover, Berger and Owen (1992) did not use a previously sedentary sample and did not control for baseline physical activity levels; thus, the relationships found between mood changes and exercise class attendance could be an artifact of the influence of baseline physical activity levels on both affective response to exercise and class attendance. Finally, Carels et al. (2006) did not control for pre-exercise affective states when examining the association between post-exercise affect and future physical activity, and thus it is possible that baseline affect influenced both post-exercise affect and subsequent physical activity behavior.

In the present study, we sought to overcome these limitations by examining the association between basic affective responses to a moderate-intensity exercise stimulus with future physical activity participation among previously sedentary adults participating in a moderate-intensity physical activity promotion intervention. Specifically, we examined affective response to moderate-intensity exercise during a baseline graded submaximal exercise test in order to determine if these responses could predict physical activity participation at 6 and 12 months. In order to reduce the chances of confounding, we controlled for affective responses recorded prior to the graded exercise test, as well as baseline levels of physical activity. Consistent with hedonic theory, we hypothesized that those with a more positive affective response to exercise would engage in more mins of physical activity. Because previous studies have shown that positive affective responses are related to lower ratings of perceived exertion (RPE; e.g., Hardy & Rejeski, 1989), we also measured RPE in order to determine the association between affective responses to exercise and future physical activity behavior independent of RPE.

Methods

Participants

Participants were healthy, sedentary (i.e., less than 90 min of moderate-intensity physical activity per week at baseline; mean = 12.64 min; *SD* = 22.94) adults enrolled in a randomized controlled physical activity promotion trial (ANONYMOUS, in press). The parent trial from which these data were drawn had a total sample size of 249; however, the current study examined a sub-sample of participants ($n = 37$) who responded to measures relevant to the current study (i.e., Feeling Scale), which were added to the study protocol after the start of the parent trial. These participants were predominantly female (78.4%) and Non-Hispanic Caucasian (70.3%), with a mean age of 43.92 years (*SD* = 8.63) and mean BMI of 28.28 kg/m^2 (*SD* = 5.98).

Measures

Feeling Scale—The Feeling Scale (FS) is a single-item, dimensional measure of the valence dimension of affect (Rejeski et al., 1987). Participants were asked to rate their present feelings on an 11-point good/bad bipolar scale with verbal anchors at +5 = very good, +3 = good, +1 = fairly good, 0 = neutral, −1 = fairly bad, −3 = bad, −5 = very bad. The FS has been used as a measure of affective valence in a number of physical activity studies (for a review see Ekkekakis, 2003) and has been shown to be related to other measures of affective valence (Hall et al., 2002), as well as present and past physical activity participation (Hardy & Rejeski, 1989).

Rating of Perceived Exertion—Rating of Perceived Exertion (RPE) was measured using Borg's RPE scale (Borg, 1970). The scale has numerical ratings ranging from 6 to 20 with verbal anchors of 7 = "very, very light," 9 = "very light," 11 = "fairly light," 13 = "somewhat hard," 15 = "hard," 17 = "very hard," and 19 = "very, very hard." The participants were instructed on how to use the RPE scale as described in the American College of Sports Medicine guidelines (ACSM, 2005).

Physical Activity Recall—The Physical Activity Recall (PAR) assesses physical activity participation during the past 7 days. This interviewer-administered measure was originally developed for the Stanford Five City Project (Blair et al., 1985; Sallis et al., 1985). The PAR has been sensitive to change in moderate-intensity physical activity intervention trials (e.g., Dunn et al., 1999; Marcus et al., in press), and numerous studies have demonstrated its reliability and validity (for a review see Pereira et al., 1997). The primary outcome in this study is self-reported min of at least moderate-intensity physical activity.

Procedures

As part of the parent trial, participants received motivational physical activity promotion messages through either print or internet media (ANONYMOUS, 2006). Participants were encouraged to engage in moderate-intensity physical activity at least 30 min per day on most days of the week. Prior to randomization into the trial, a graded sub-maximal exercise test was performed. A Balke treadmill protocol was used that consisted of 2-min stages beginning at 4.83 km/h (3 mph) and 2.5% grade (Howley & Franks, 1992). The speed remained constant throughout the test and the grade increased 2.5% every two min until the participant achieved 85% of his/her age predicted maximum heart rate (i.e., 220-age). To obtain a baseline recording of basic affective valence, the FS was administered prior to beginning the treadmill task (pre-task FS). Participants then responded to the FS and RPE every 2 min during exercise testing beginning at min 2.[1] Heart rate data were obtained every min.

Because intervention goals involved exercising at moderate-intensity, we used FS and RPE data reported at the min when each participant first recorded a heart rate within the moderate-intensity range (i.e., above 64% of age predicted maximum heart rate; ACSM, 2005, p. 4) to predict future physical activity participation. Data from 71 additional participants were not examined because they did not have FS responses (recorded every two min) at the time that they first recorded a heart rate (recorded every min) in the moderate-intensity range (i.e., above 64% age-predicted max). Because the intensity of the exercise task was increased at 2-min intervals, and the study sample was highly deconditioned, resulting in rapidly increasing heart rates (i.e., mean total time to reach the cutoff of 85% predicted HR was 478.1 sec; *SD* = 138.7), it was not expected that the FS responses to a higher intensity of exercise would be predictive of future moderate-intensity physical activity, and thus the data from these participants were not relevant to our research question.

The PAR was administered at baseline, 6, and 12 months. Of the 37 participants who completed the baseline measures, 31 (84%) also completed the 6- and 12-month PAR. Analyses involving the 6- and 12-month PAR include only those participants who completed these assessments.

Results

Table 1 shows descriptive statistics for all analyzed variables. Compared to those who completed 6- and 12-month assessments, the 6 participants who did not return for follow-up assessments had less education ($\chi^2 = 10.5$, $p = .015$). Though statistically non-significant, study dropouts also reported higher baseline scores on FS responses and more min of physical activity than study completers.

Consistent with previous research (Ekkekakis et al., 2000; Van Landuyt et al., 2000), there was considerable variability in the FS scores recorded when participants reached moderateintensity (i.e., in-task FS; M = 2.24; *SD* = 1.52; range: −1 to 5). Relative to their pre-task affect, 27%

[1]Due to protocol changes that occurred during the intervention, 3 participants responded to these measures at min 1, 3, 5, etc.

(*n* = 10) of participants had a positive affective response to moderate-intensity exercise, 29.7% (*n* = 11) had a negative response, and 43.2% (*n* = 16) remained unchanged.

We computed bivariate correlations among the analyzed variables as a preliminary check on predictive validity of our measures (Table 1). All correlation coefficients among FS, RPE, and min of physical activity reported on the 6- and 12-month PAR were in the expected direction. Consistent with our hypothesis, we fit regression models testing the association between FS and 6- (Table 2) and 12-month PAR min (Table 3) when controlling for pre-task FS score and baseline PAR min.[2] As hypothesized, FS responses to the moderate-intensity stimulus predicted both 6-month PAR min (β = .51, $p = .013$) and 12-month PAR min when including 6-month PAR min as an additional covariate (β = .45, $p = .047$). When RPE was added to the respective models, the association between FS and both 6-month PAR min (β = .35, $p = .085$) and 12-month PAR min (β = .43, $p = .063$) became non-significant. RPE was related to 6-month PAR min (β = −.39, $p = .043$), but not 12-month PAR min (β = −.05, $p = .802$).[3]

We computed R^2 values to examine the additional variance in 6- and 12-month PAR min explained by adding the variables of interest to the 6- and 12-month models (Table 2 & Table 3). Adding FS responses (to the moderate-intensity stimulus) to pre-task FS and baseline PAR min explained an additional 20% of the variance in 6-month PAR min (not shown). The further addition of RPE to the 6-month model explained an additional 12% of the variance in 6-month PAR min (Table 2). Similarly, adding FS responses to pre-task FS, baseline PAR min, and 6-month PAR min explained an additional 12% of the variance in 12-month PAR min (not shown), while the further addition of RPE to the 12-month model explained less than 1% of the variance in 12-month PAR min (Table 2). Finally, we reversed the order of entry of the FS and RPE variables to examine the additional variance explained by FS responses when added to models already including pre-task FS, baseline PAR min, 6-month PAR min (12-month model only), and RPE. Adding FS responses to the full models resulted in an additional 8% of explained variance in 6-month PAR min and 11% of variance in 12-month PAR min (not shown).

Discussion

Our findings indicate that sedentary participants who reported more positive affective responses to a moderate-intensity stimulus during a single bout of exercise at baseline reported more min of physical activity both 6 and 12 months later. The magnitude of the coefficients were in the moderate range based on Cohen's (1977) description of effect sizes for social science research. In practical terms, a shift of one unit on the FS was associated with an increase of 38 min of physical activity per week at 6 months, when controlling for pre-exercise affective state and baseline physical activity. Likewise, a shift of one unit on the FS was associated with an increase of 41 min of physical activity per week at 12 months, when controlling for pre-exercise affective state, and baseline and 6-month physical activity. Unlike previous studies examining affective responses to exercise and future physical activity participation (Annesi, 2005; Annesi, 2002a, 2002b; Berger & Owen, 1992; Carels et al., 2006; Klonoff et al., 1994), the present study measured *basic* affective response *during* a moderate-intensity exercise stimulus as a predictor of future moderate-intensity physical activity participation.

The results are consistent with hedonic theory (Kahneman, 1999; Young, 1952), as well as recent applications positing that immediate affective consequences of exercise may determine

[2]We did not control for treatment assignment as FS data were obtained prior to randomization into the trial, and thus were uncorrelated with treatment condition.

[3]Because there was variability in the percent of age-predicted maximum heart rate at which FS and RPE data were collected, we reran all of the regression analyses controlling for this variable and found no difference in the results, with one exception: In the 12-month model, FS responses were somewhat less predictive and not statistically significant prior to controlling for RPE (β = .42, $p = .056$).

future physical activity participation (Cabanac, 2006; Ekkekakis et al., 2005). This may be especially important in the context of physical activity research, where the focus has typically been on instrumental rather than affective outcomes of exercise (Williams, Anderson, & Winett, 2005). The findings provide mixed support, however, to the hypothesis that affective response to exercise adds to the prediction of future physical activity participation above and beyond the influence of RPE. Consistent with previous research (e.g., Hardy & Rejeski, 1989), RPE was negatively associated with FS ratings taken at moderate-intensity. When controlling for RPE the relationship between affective response and future physical activity participation became non-significant. This suggests some commonality in the variance in physical activity participation that is explained by affective response and RPE. Despite the common variance in affective valence (i.e., FS) and perceived exertion (i.e., RPE), it should be noted that they are conceptually and empirically distinct constructs (e.g., Hardy & Rejeski, 1989). Indeed, the magnitude and near statistical significance of the coefficients for FS in the 6- and 12-month models suggest that the association between affective response and physical activity participation may be mostly independent of RPE. Taken together, the results indicate that affective variables deserve more attention as predictors of physical activity participation; however, further research is needed to clarify the relationship between affective response to exercise and future physical activity independent of perceived exertion.

The findings also have practical implications. Ekkekakis et al. (2004) have argued that basic affective response to exercise may be an effective means for prescribing exercise intensity among the general population. For example, participants might be asked to exercise at the highest intensity possible before experiencing a negative turn in affective valence. Given the present findings indicating an association between more positive affective response to exercise and greater exercise adherence, as well as present and previous findings (Ekkekakis et al., 2000; Van Landuyt et al., 2000) showing a variable affective response to moderate-intensity exercise (as defined by percent of maximal heart rate), one would expect that a prescription such as this would lead to greater adherence than a prescription based on moderate-intensity. Moreover, such a prescription, if maintained, may lead to considerable health benefits. Specifically, Ekkekakis et al. (2004) found that exercise at or just below the ventilatory threshold (VT; the point at which metabolism begins to transition from aerobic to anaerobic supplementation) elicited an increasingly positive affective response that leveled off and then became more negative as the ventilatory threshold was exceeded (Ekkekakis et al., 2004). Exercise at or just below the VT, in turn, has been shown to have significant health benefits (e.g., Astorino, 1997), potentially as good or better than those obtained when exercising above the ventilatory threshold (Aellen, Hollmann, & Boutellier, 1993; Boucher et al., 1985; Londeree, 1997; Tanaka et al., 1986; Weltman et al., 1992) or at moderate-intensity as defined by percent of maximal heart rate (Ahmaidi et al., 1998; for a review see Ekkekakis et al., 2004; Fabre, Masse-Biron, Ahmaidi, Adam, & Prefaut, 1997; Vallet et al., 1997). Thus, affective response may be useful as a proxy for VT on which to base prescriptions that are potentially more sustainable and beneficial than traditional prescriptions based on percent of maximal heart rate. The links between VT and affective response (Ekkekakis et al., 2004), and affective response and physical activity participation (present findings) have been made, albeit separately. Additional research is needed to establish the direct link between exercising at the VT and exercise sustainability, and the mediating role of affective response.

The current study had a number of limitations. First, the small sample size led to reductions in power that may have led to Type II errors. Most prominently, when controlling for RPE the magnitude of the association between FS and 6- and 12-month PAR remained moderate, despite its non-significance, suggesting the possibility of a Type II error. The small sample, coupled with baseline differences between study completers versus dropouts, also limits the generalizability of the findings. Second, due to the correlational nature of the data, no causal conclusions can be drawn. Despite the longitudinal design, some unmeasured third variable, such as personality, may influence both positive affective responses to exercise and future physical activity participation. Future research should use experimental approaches to determine the causal impact of acute affective responses to exercise on physical activity participation Third, use of age-predicted maximum heart rate as a demarcation of moderate-intensity exercise is not ideal, as maximal heart rate testing would have provided better estimates of each participant's moderate-intensity threshold. Fourth, because we did not measure affect following the initial bout of exercise, we cannot compare in-task versus post-task affective response to exercise as predictors of future physical activity. Although learning theory posits that immediate consequences of behavior are more predictive of future behavior than distal consequence (e.g., Neef, Shade, & Miller, 1994), future research should test the predictive utility of in-task versus post-task affective response to exercise on future physical activity. Fifth, the current study did not examine the potential mechanisms through which affective responses to exercise may impact future physical activity participation. For example, both decision affect theory (Mellers, 2000; Mellers, Schwartz, Ho, & Ritov, 1997) and response expectancy theory (Kirsch, 1990) posit that expected affective responses to behavior impact future behavioral choice. Future studies should examine expected affective responses to exercise as a potential link between actual affective responses to initial exercise behavior and future physical activity participation.

A final limitation of the study provides multiple avenues for future research. Specifically, given the progression in exercise intensity during the graded baseline exercise task, we used a single data point, taken when participants were at moderate-intensity, to predict future physical activity participation. While this methodology is consistent with the aims of the intervention program – to encourage moderate-intensity physical activity – analyses of the proposed relationship between affect and physical activity hinge on a single FS data point. A stronger design would be to assess, at multiple time points, affective responses to an exercise task that more closely resembles an actual bout of moderate-intensity physical activity. Such a design would allow for fine-grained testing of more specific theoretical principles involving affective response and future behavior. For example, Kahneman and colleagues have proposed and shown evidence for a peak-and-end effect, in which global evaluations of behavioral experiences and subsequent decisions to repeat the behaviors are most influenced by peak affective experiences (either most pleasurable or aversive) and affect at the end of the experience (note: as opposed to following the experience), while duration of the experience is largely ignored in affective evaluations (Fredrickson & Kahneman, 1993; Kahneman, Fredrickson, Schreiber, & Redelmeier, 1993; Varey & Kahneman, 1992). Brewer, Manos, McDevitt, Cornelius, and Raalte (2000) applied this theory in a study examining global evaluations and preference for repeating one of two different exercise stimuli that elicited varying levels of discomfort through changing the exercise intensity at 5-min intervals. The two exercise stimuli were identical through the first 15 min, after which the first stimulus ended and the second stimulus continued for another 5 min of exercise that was rated as aversive, but less so than the previous 5 min. All participants engaged in the two exercise protocols in a counter-balanced fashion. As hypothesized, more participants preferred the 20-min exercise stimulus to the 15-min exercise stimulus (13 to 7) despite the additional 5 min of aversive exercise in the 20-min stimulus. These findings were consistent with the notion that the end of a behavioral experience is more influential than duration of the experience in formulating global evaluations of the experience (Fredrickson, 2000)

Several aspects of the current design precluded testing of the peak-and-end rule. First, uncontrolled variability in duration and relative intensity of the baseline exercise stimulus did not allow for isolation of peak, end, or duration effects on future behavior. Second, in Brewer et al. (2000), participants were asked to report their preference for repeating a specific 15- or 20-min exercise bout that varied in intensity every 5 min. In the current study, our goal was to capture how participants reacted affectively to walking at a moderate-intensity, rather than to their peak, end, or global affective response to the entire exercise stimulus—a graded exercise test. Because participants were not asked to repeat the baseline task (i.e., graded exercise test), global evaluations of the baseline exercise task were not relevant as predictors of prescribed moderate-intensity exercise. Instead, we sought to capture how participants may feel in response to moderate-intensity exercise by using their affective ratings from the time during the graded exercise test that they were in the moderate-intensity range. Future studies might test the peak-and-end principle by having participants walk for a controlled period of time at a relative intensity that is prescribed for future exercise, and then measure peak and ending affective valence as a predictor of future exercise behavior in the same intensity range.[4]

In summary, the current study showed that among previously sedentary adults: (1) acute affective responses to a moderate-intensity exercise stimulus predicted physical activity participation 6 and 12 months later; (2) this relationship became non-significant when controlling for ratings of perceived exertion; and (3) ratings of perceived exertion were independently associated with physical activity participation at 6 months but not 12 months. A strength of the study was the prospective design, which yielded an association between affective response to exercise and future physical activity participation. Such a relationship is consistent with hedonic theory (e.g., Kahneman, 1999; Young, 1952), and could pave the way for continued improvement upon existing exercise interventions.

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Table 1

Correlations and Descriptive Statistics Among Baseline FS, Baseline RPE, Pre-Task FS, Baseline PAR, 6 Month PAR and 12 Month PAR

Measure	Min	Max	Mean	*SD*	1	2	3	4	5	6
1. FS	−1.00	5.00	2.24	1.52		−.35*	.49**	.32	.50**	.47**
2. RPE	7.00	19.00	11.41	2.27			−.14	.20	−.48**	−.29
3. Pre-Task FS	−1.00	5.00	2.30	1.76				.33	.13	.18
4. Baseline PA min	0.00	85.00	12.64	22.94					.20	.11
5. 6-Month PA min	0.00	390.00	145.74	116.91						.50**
6. 12-Month PA min	0.00	600.00	131.10	141.52						

* $p<.05$

** $p<.01$

Note. FS = Feeling Scale. RPE = Rating of Perceived Exertion. PA = Physical Activity of at least Moderate-intensity.

Table 2

Two-Step Linear Regression Analysis for Predicting 6-Month Physical Activity

Step 1			Overall model fit: F (3,26) = 2.864, p = .056			
	Variable		***B***	***SE B***	**β**	***p***
	Constant		75.92	34.00		
	Baseline PA min		0.33	0.92	0.07	0.725
	Pre-Task FS		−6.98	12.30	−0.11	0.575
	FS		38.12	14.37	0.51	0.013
Step 2		Change in R^2 = .12	Overall model fit: F (4,25) = 3.575, p = .019			
	Variable		*B*	*SE B*	β	p-value
	Constant		313.33	115.94		
	Baseline PA min		1.05	0.93	0.21	0.267
	Pre-Task FS		−8.19	11.55	−0.13	0.485
	FS		26.19	14.60	0.35	0.085
	RPE		−18.93	8.89	−0.39	0.043

Note. FS = Feeling Scale. RPE = Rating of Perceived Exertion. PA = Physical Activity of at least Moderate-intensity.

Table 3

Two-Step Linear Regression Analysis for Predicting 12-Month Physical Activity

Step 1			**Overall model fit: *F* (4,23) = 3.563, *p* = .021**			
	Variable		***B***	***SE B***	**β**	***p***
	Constant		9.15	46.30		
	Baseline PA min		−0.66	1.09	−0.11	0.549
	6-Month PA min		0.39	0.24	0.30	0.118
	Pre-Task FS		−0.07	15.55	−.001	0.997
	FS		40.97	19.48	0.45	0.047
Step 2		Change in R^2 < .01	Overall model fit: *F* (5,22) = 2.748, *p* = .045			
	Variable		*B*	*SE B*	β	p-value
	Constant		51.01	171.44		
	Baseline PA min		−0.53	1.23	−0.09	0.670
	6-Month PA min		0.36	0.27	0.28	0.191
	Pre-Task FS		−0.41	15.93	−0.01	0.980
	FS		39.90	20.33	0.43	0.063
	RPE		−3.17	12.47	−0.05	0.802

Note. FS = Feeling Scale. RPE = Rating of Perceived Exertion. PA = Physical Activity of at least Moderate-intensity.