
Faculty of Education

Faculty Publications

This is a post-print version of the following article:

Affective response to exercise and affective judgments as predictors of physical activity intention and behavior among new mothers in their first six-months postpartum

Ryan E. Rhodes, Chris M. Blanchard, Kimberly R. Hartson, Danielle Symons Downs, Darren E. R. Warburton, & Mark R. Beauchamp

2023

The final publication is available at:

<https://doi.org/10.1093/abm/kaac067>

Citation for this paper:

Rhodes, R.E., Blanchard, C. M., Hartson, K. R., Symons Downs, D., Warburton, D. E. R., & Beauchamp, M.R. (2023). Affective response to exercise and affective judgments as predictors of physical activity intention and behavior among new mothers in their first six-months postpartum. *Annals of Behavioral Medicine*, 57(4), 344–353. <https://doi.org/10.1093/abm/kaac067>

Affective Response to Exercise and Affective Judgments as Predictors of Physical Activity

Intention and Behavior among New Mothers in their first Six-Months Postpartum

Ryan E. Rhodes¹, PhD, Chris M. Blanchard², PhD, Kimberly R. Hartson³, PhD

MSc, Danielle Symons Downs⁴, PhD, Darren E.R. Warburton^{5,6}, PhD, Mark R. Beauchamp, PhD⁵

Affiliations: ¹University of Victoria, School of Exercise Science, Physical and Health Education, Victoria, Canada, ²Dalhousie University, Faculty of Medicine, Halifax, Canada, ³University of Louisville, School of Nursing, Louisville, U.S.A., ⁴The Pennsylvania State University, Departments of Kinesiology and Obstetrics and Gynecology, University Park, U.S.A., ⁵University of British Columbia, School of Kinesiology (Faculty of Education), ⁶Experimental Medicine Program (Faculty of Medicine), Vancouver, Canada,

Address correspondence to: Ryan E. Rhodes, Ph.D. (ORCID 0000-0003-0940-9040), Behavioural Medicine Laboratory, School of Exercise Science, Physical and Health Education, PO Box 3010 STN CSC, University of Victoria, Victoria, B.C., V8W 3N4 CANADA, Tel: (250) 721-8384, Fax: (250) 721-7767, EM: rhodes@uvic.ca

Financial Disclosure: The authors have no financial relationships relevant to this article to disclose.

Conflicts of Interest: The authors have no conflicts of interest relevant to this article to disclose.

Funding Source: The trial was funded by the Canadian Institutes of Health Research Grant # 133614.

Registered Trial: clinicaltrials.gov # NCT02290808

Analytic Plan and code: The analyses in this paper are secondary analyses. Analyses were conducted in SPSS 26.

Data and materials availability: We have full control of these data and study materials and can provide these to the journal and interested readers at request in aggregate form (correspondent with our ethics approval).

CREDiT: Ryan E. Rhodes – Conceptualization, Formal Analysis, Funding Acquisition, Methodology, Writing – Original Draft; Chris Blanchard - Conceptualization, Funding Acquisition, Methodology, Writing – Review and Editing; Kimberly Hartson - Writing – Review and Editing; Danielle Symons Downs - Conceptualization, Funding Acquisition, Methodology, Writing – Review and Editing; Darren Warburton - Conceptualization, Funding Acquisition, Methodology, Writing – Review and Editing; Mark Beauchamp - Conceptualization, Funding Acquisition, Methodology, Writing – Review and Editing

Keywords: Affect and Health Behavior Framework; Affective Attitude; Intention; Parenthood

Lay Summary: Understanding the predictors of moderate to vigorous physical activity (MVPA) during early postpartum is important to improve promotion efforts. Affect-related constructs are key predictors of MVPA but have limited research in mothers during the postpartum period. The purpose of this study was examine two affect-related constructs (affective response to exercise and affective judgments) as predictors of MVPA intention and behavior across three months, among a sample of new mothers. Participants were 105 mothers who completed measures of affective response to exercise (assessed at 2 months post-partum during a submaximal treadmill test), affective judgments and intention (2 months postpartum, and 6-weeks after), and MVPA (2 months postpartum, 6- and 12-weeks after). The affective response during exercise was a significant predictor of intention as well as change in intention over time. By contrast, affective judgments was a less reliable predictor across the study. Interventions targeting women's affective response during exercise may be important during postpartum, perhaps through self-paced physical activity guidance. Affective judgments may not be predictive of MVPA, in part due to unanticipated changes during early postpartum leading to inaccurate expectations of the physical activity experience.

Abstract

Background: Understanding the predictors of moderate to vigorous physical activity (MVPA) during early postpartum is important to improve promotion efforts. Affect-related constructs are key predictors of MVPA but have limited research in mothers during the postpartum period.

Purpose: To examine two affect-related constructs (affective response to exercise and affective judgments) as predictors of MVPA intention and behavior across three months, among a sample of new mothers.

Method: Participants were 105 mothers (M age = 30.64 yrs; SD = 3.93) who completed measures during postpartum at two-months post birth of their first child. The affective response to exercise (assessed at baseline [2-months postpartum] during a submaximal treadmill test), affective judgments and intention (baseline, 6-weeks after baseline), and MVPA (baseline, 6- and 12-weeks after baseline) were assessed via self-report. **Results:** Path analysis, using ordinary least squares regression, showed that the affective response during exercise was a significant predictor of intention (baseline, 6-weeks), as well as change in intention from baseline to 6-weeks. By contrast, affective judgments predicted intention at 6-weeks, but not at baseline or in the change model. Past MVPA did not moderate these findings, although the affective response during exercise also had a significant indirect effect on MVPA through intention at 6-weeks and 12-weeks.

Conclusions: Interventions targeting women's affective response during exercise may be important during postpartum, perhaps through self-paced physical activity guidance. Affective judgments may not be predictive of MVPA, in part due to unanticipated changes during early postpartum leading to inaccurate expectations of the physical activity experience.

Keywords: Affect and Health Behavior Framework; Affective Attitude; Intention; Parenthood

Affective Response to Exercise and Affective Judgments as Predictors of Physical Activity
Intention and Behavior among New Mothers in their first Six-Months Postpartum

Physical activity is associated with numerous health benefits and a reduced risk of over 25 chronic health conditions (1, 2), yet many adults fail to meet the recommended international health guidelines of 150 minutes of accumulated moderate-to-vigorous intensity physical activity (MVPA) per week (3). The prevalence of MVPA, however, is not uniform across the adult population (4), so promotion efforts may need to concentrate on certain adults at particular risk of physical inactivity more than others. New mothers during the postpartum period (i.e., typically defined as the period after childbirth up to 12 months) (5), typically report decreases in MVPA from before pregnancy and also report less MVPA than women of a comparable age without children (6, 7). This is concerning, because MVPA during the postpartum period is associated with many benefits, such as reduced chances of chronic disease (8), reduced depressive symptoms (9), increased chances for a sustained pattern of regular MVPA (10), and physical activity among their children (11).

The demands of early motherhood likely influence lifestyle changes, which in turn, may compromise the pursuit of MVPA (12, 13). This assumption has been supported in research underpinned by social cognitive frameworks such as the theory of planned behavior (14) and social cognitive theory (15). Specifically, lower perceived behavioral control (10, 16, 17) or self-efficacy (18, 19) due to caregiving commitments has been reported as a critical barrier that depletes MVPA intentions and behavior.

While social cognitive approaches to understanding MVPA participation have been supportive in predicting and changing physical activity among mothers during the postpartum period (20, 21), mainly via engaging attitude change (e.g., information, education) and building self-regulation skills (e.g., planning, self-monitoring), these approaches often show only short-term behavioral changes and modest effects. Thus, recent theoretical advances in health and physical

activity psychology have emphasized the importance of also considering less-rational determinants of behavior such as affect-related determinants (22-26). Using the affect and health behavior framework (AHBF) as a guide (27, 28), affect and affect-related constructs are proposed to influence MVPA both indirectly, via cognitively processed expectations and intentions, and directly via operant conditioning of learned associations that are enacted impulsively (24, 29).

Two constructs that may best represent these differing affective properties include the affective response to exercise and affective judgments (27). The affective response to exercise (i.e., how one feels in response to physical activity behavior) can only be experienced *in vivo*, and thus is measured as core affect (valence) while a participant is engaging in MVPA. Its proposed effect on future physical activity is commensurate with hedonic theories, where engaging in behavioral action/inaction is hypothesized to occur largely via an impulsive manner from learned association of pleasure/displeasure respectively (30-32). By contrast, affective judgments are proposed to be comprised of cognitively processed expectations of enjoyment, fun, and pleasure (27, 33) and are formed at a time before the actual enacted behavior (e.g. earlier that day, week or month). Because affective judgments are cognitively processed affective expectations, they are hypothesized to determine behavior more in alignment with traditional social cognitive theories, thereby influencing behavior through intentions (34).

Research evidence has been generally supportive of the proposed effects of the affective response to exercise and affective judgments on MVPA. Specifically, Rhodes and Kates (35) reviewed the evidence for the prediction of MVPA based on one's affective response during a prior bout of exercise. Four studies (36-39) showed that the affective response during a bout of moderate-intensity exercise, after controlling for pre-exercise affect, predicted MVPA up to six months later. The effect ranged from $r = .18$ to $r = .51$ across studies, however, suggesting considerable heterogeneity in the effect size. Interestingly, Rhodes and Kates (35) also found that

in six of nine studies that evaluated the relationship between post-exercise affective response and future MVPA, post-exercise affective response did not predict future behavior; thus supporting the importance of during-exercise affect over post-exercise affect (35). Reviews focused on affective judgments have also shown that the construct is a consistent predictor of MVPA in the medium effect size range (33, 40, 41), and that it is a considerably larger predictor of behavior (and intention) than instrumental (i.e., expectations that a behavior is useful) judgments (33, 41).

Despite this emerging evidence-base, there are still limitations to the literature that warrant investigation and may be particularly poignant to understanding the MVPA of women during the postpartum period. Specifically, past research on the affective response to exercise has been conducted with undergraduate students, youth, and samples of middle-aged adults. The relationship between the affective response to exercise and MVPA in postpartum mothers has not been explored to our knowledge. There is good reason to assume that the affective response to exercise may be a significant predictor of MVPA for postpartum women. The affective response to moderate intensity physical activity feels different based on body weight and conditioning (42); thus, mothers beginning or reinstating MVPA after the physiological changes that occurred during pregnancy and postpartum may experience a salient affective response that would conceivably influence future physical activity participation. Preliminary evidence is supportive of this conjecture. For example, in a survey of barriers and benefits to MVPA among postpartum women, 55% of participants reported feeling uncomfortable during exercise as a barrier to participation (down from 90% during pregnancy) (43). A formal test of the affective response to exercise as a predictor of future MVPA, is needed to further this line of evidence.

Second, from a theoretical standpoint, there is still a need to test the proposed mechanisms for how the affective response to exercise and affective judgments affect MVPA. There is ample research on affective judgments and MVPA to support the premise that most, but not all, of this

relationship is mediated by intentions (33, 41) as proposed in the AHBF (27). By contrast, there is currently mixed evidence for whether the affective response to exercise predicts MVPA independent of intentions (35). There is also limited evidence on whether the affective response to exercise predicts MVPA independent of affective judgments (35), which may act as a mediator of this relationship (44), contrary to the direct effect proposed in the AHBF (27).

With these limitations in mind, the purpose of this secondary analysis was to examine the affective response to exercise and affective judgments as predictors of MVPA intention and behavior across time, among a sample of new mothers (2 months postpartum) who participated in a randomized trial. The original trial outcomes, reported elsewhere (45), showed that the intervention did not have a differential effect on MVPA behavior or intention in comparison to the control condition; however, mothers (across both conditions) responded with improvements in MVPA over time. Commensurate with the AHBF (27), we proposed that both the affective response during exercise and affective judgments about MVPA would predict future MVPA independently. Also corresponding with the AHBF, we further proposed that affective judgments would predict MVPA through intention, yet the affective response during exercise would predict MVPA independent of intention. Similar to past research (35), we hypothesized that the affective response post-exercise would not have as strong of an effect on future MVPA as the affective response during exercise. Finally, research has found that past MVPA and the affective response to exercise may be positively linked (46). We advanced upon these findings of a basic bivariate relationship by exploring whether past MVPA moderated the association between the affective response to exercise and intention and future MVPA. We hypothesized that synergy (high past behavior, positive affective response) between past MVPA and subsequent affective response to exercise may better predict intention and MVPA compared to those who report lower MVPA at baseline.

Methods

Design

Detailed information about the methods and main outcomes of this trial have been published (45, 47, 48), where we followed CONSORT reporting standards (49). Briefly, the study was a two-arm parallel design, randomized trial, where couples were randomized for 1:1 allocation to either a planning with information/education group or the physical activity information/education only group. The primary outcome for the trial corresponded to an assessment of differences in MVPA between the trial conditions, which is reported elsewhere (45) and the prediction of MVPA using theory of planned behavior (14) and multi-process action control (50) has also been published (47). For the purpose of this secondary analysis, women were analyzed as a single group because there were no significant differences in MVPA between conditions. The major outcomes included in the secondary analysis were affective response measurement, which was assessed at baseline (2-months postpartum), and affective judgments, intention, and MVPA, which were assessed at baseline and subsequently assessed at 6- and 12-weeks after baseline.

Participants

Rolling recruitment began in November 2014 and was completed in July 2017. Recruitment took place at clinical, community, and online avenues. Advertisements were distributed through doctor's offices, health centers, midwifery services, recreation centers, maternity and baby stores, and any other community organizations offering prenatal classes. In-person recruitment initiatives took place at community fairs (e.g., baby fairs), health shows, and community markets. If participants could also recruit another to the study, they received a \$25 CAN grocery store gift card.

Inclusion criteria. In these secondary analyses, participants were mothers with common law or married partners who were two months post-birth of their first child at study commencement. Participants were screened for physical activity readiness via the Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) (51). Those individuals who were not ready or able to

participate in MVPA were excluded, but no exclusion was based on past MVPA. Participants in this secondary analysis, were also those who completed an assessment of the affective response to exercise during a treadmill fitness test during baseline assessment procedures. This assessment was added as an addendum to the ethics protocol as a secondary research question in February 2015.

Measures

Primary Outcome: Minutes of MVPA

Minutes of MVPA was measured by self-report using a modified Godin Leisure-Time Questionnaire (GLTEQ; 52, 53). Specifically, weekly frequency and duration of physical activity were provided with an open-ended assessment identical to the International Physical Activity Questionnaire (54) and the multiplicative (frequency x duration) sum of moderate and vigorous intensity minutes were used as the estimate of weekly MVPA (55). While the outcome of interest was MVPA, the light-intensity category was also included in the measure, so that participants did not “bump up” their light-intensity exercise into the moderate intensity category within their response options (55). The instrument asked about a typical week within the epoch of the assessment frame (e.g., over the last six weeks). Descriptors of each type of intensity physical activity were included within the measure, identical to the standard GLTEQ.

Predictor Measures

Both intention and affective judgments were framed in terms of expectations of achieving 150 minutes of MVPA per week. Examples of different ways (bouts, mode, frequency) to achieve this MVPA on a regular basis were provided in the description commensurate with public health guidelines (56). Baseline and six weeks assessment asked for expectations of accruing MVPA over the next six weeks. *Affective judgments* were measured on five-point scales with three affective (i.e., unenjoyable-enjoyable, boring-stimulating, unpleasant-pleasant) semantic differential items (time 1 $\alpha = 0.67$; time 2 $\alpha = 0.65$). *Intention strength* (57) was measured by two items on five-point

scales ranging from strongly disagree to strongly agree. The items were “Over the next six weeks, I am motivated to be physically active on a regular basis” and “Over the next six weeks, I am determined to be physically active on a regular basis” (time 1 $\alpha = 0.86$; time 2 $\alpha = 0.87$).

Affective response to exercise was measured with the Feeling Scale (58). The feeling scale is a single-item measure of core affective valence (27). 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 feeling scale has been used as a measure of affective valence in a number of physical activity studies (35). Affective response during exercise was measured by taking the residual change score from the assessment during exercise after controlling for baseline. Similarly, affective response post-exercise was measured by taking the residual change score from the assessment after exercise after controlling for baseline. For the sake of representing all possible profiles of the affective response, we also created a residual change measure of the during-to-after affective response to exercise.

Procedures

Study protocol and assessment have been reported elsewhere (59). Briefly, the lead trial coordinator conducted study protocol quality control training and cross-checks with all research assistants. After interested participants contacted the researcher and were determined to be initially eligible to participate in the study, the trial coordinator explained the study and collected informed consent, followed by the scheduling of a baseline assessment at the laboratory that corresponded with the approximate date for contact for each woman at two months after childbirth.

Critical to this secondary research study, mothers completed a submaximal Ebbeling treadmill test (60) at baseline where the affective response to moderate-intensity physical activity was assessed. The feeling scale was assessed while participants were seated and resting 2 min before test performance, at 2 min after the gradient increase during the treadmill test (i.e., between

50% to 70% age-predicted HRmax), and immediately after test completion. Specifically, participants began with a warmup for 4 minutes at a 0% grade and a walking speed that brought the HR to between 50% and 70% of their HRmax (the recommended walking speed is from 3.4 to 4 mph). If the HR was not in this range after the first minute, the speed was adjusted accordingly. Following the warm-up, the participant was kept at the same speed for an additional 4 minutes at a grade of 5%, the fitness tester recorded the steady-state HR from the average of the final 30 sec of the last two minutes at the 5% grade.

At 6 and 12 weeks after the baseline assessment, a member of the research team met with parents to conduct subsequent assessments with the self-report measures of MVPA, affective judgments, and intention. As an incentive for participants to complete all assessments, an honorarium was provided starting at \$25 at baseline and increasing by \$5 at each time point.

Statistical Analyses

Data were analysed in SPSS 26 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated for the variables across time, after which the normality of the variables was examined and transformed if necessary. Prediction of MVPA with the two affective constructs and intention included the baseline to week 6 and week 6 to week 12 epochs. This approach directly aligned with how we assessed intention and affective judgments at baseline and then again at six weeks into the trial with the questionnaire phrasing that asked participants to think about engaging in MVPA over the next six weeks. The baseline affective response variable was included in both prediction equations (i.e., MVPA at 6- and 12-weeks; intention at baseline and 6 weeks).

Both prospective behavior as well as prospective behavior regressed upon past behavior were explored as outcomes to assess behavior and behavior change, respectively (61). Prediction of intention and change in intention from baseline to six-weeks by the affect-related variables was also explored within the path models. Our test of whether past MVPA moderated the affective response

was conducted only on the regular intention and MVPA models (i.e., not the analyses of change models).

Ordinary least squares regression analyses with path analysis were used to predict intention and MVPA during these epochs. The PROCESS macro for SPSS (62) was used (5000 bootstrapped samples) to investigate any indirect effects of affective judgments and the affective response to exercise through intention across the path models. To examine past MVPA as a moderator, we configured past MVPA both as a continuous variable (total MVPA minutes) and as a binary measure corresponding meeting (or not) MVPA guidelines of at least 150 minutes (63). Main effects (affective response, past MVPA) in the model for these exploratory analyses were grand mean-centred and the interaction term (i.e., past MVPA x affective response) was entered into the regression equation in a subsequent forced-entry hierarchical analysis. The original trial outcomes (45) were powered for a minimum sample of 128 participants. For this secondary analysis, our post hoc power analysis suggested that a sample of 95 participants was sufficient to detect a small effect size ($f^2 = .12$) for the three independent variables in our proposed model tests, and for the test of an incremental F change ($f^2 = .08$) using a single interaction variable (past MVPA x affective response; $\alpha = .05$; power = .80) (64).

Results

Participant Flow and Baseline Characteristics

Of the 132 mothers who participated in the original trial (45), 108 (81.8%) participants completed measures of the affective response during exercise and were included in this secondary analysis study. The sub-set of participants was due to the late addition of the affective response during exercise measure to the protocol. There were no differences in age, condition assignment, race, education, occupational status, income, or baseline physical activity between the secondary analysis sub-sample and the original study sample ($p > .05$). Furthermore, 97% (N = 105) of this

sub-sample completed the protocol through the 12-week post-baseline end-point in this secondary analysis study, thus representing the final sample size. Reasons listed for dropping out included moving cities (n=2), and unable to contact (n=1). No participants cited harms associated with the study.

Mothers (100% female) reported a mean age of 30.64 years (SD = 3.93), and were 84% white (12% Asian, 1% Indigenous, 3% not reported), university educated (77%), employed (58%), and approximately equally distributed at the median income for Canadian adults (>\$75,000, 51%). Fifty-eight percent of the sample reported meeting MVPA recommendations before pregnancy, 96% were breastfeeding, and the sample reported 6.3 (SD = 1.15) hours of sleep per night on average.

Prediction of Intention and MVPA

Descriptive statistics and correlations among all variables are presented in Table 1. All variables were normally distributed (e.g., skewness < 2) so we did not engage in transformation. Affective judgments (Baseline mean = 4.35; 6 weeks mean = 4.38) and intention (Baseline mean = 4.26; 6 weeks mean = 4.00) to engage in MVPA were both generally favorable on the five point-scale, and the affective response to exercise during (mean = 0.13) and after (mean = 0.15) were also more favorable, on average, than pre-exercise. Of note, the affective response during and after exercise were not correlated with affective judgments or MVPA at 6- or 12-weeks ($p > .05$). By contrast, both the affective response during exercise and affective judgments were correlated with intention at 6- and 12-weeks, respectively.

Affective response during exercise.

Figure 1a details the path model for affective judgments, the affective response during exercise, and intention at baseline predicting MVPA at six weeks, and Figure 1b highlights the path model for affective judgments and intention at six weeks, and the affective response during exercise

at baseline, predicting MVPA at 12 weeks. Comparable models are presented with unstandardized residuals in Supplemental Figure 1 that involve the prediction of *change* in physical activity (over 6 and 12 weeks). Intention predicted ($p < .05$) MVPA at 6- and 12-weeks, and baseline intention also showed a borderline effect ($p = .06$) when predicting change in 6-week MVPA in the residual model (R^2 range .09 to .15). Across all models, however, affective judgments and the affective response during exercise did not show direct effects on MVPA after controlling for intention ($p > .10$).

The affective response during exercise was a significant predictor of both intention at baseline and 6-weeks, as well as change in intention from baseline to 6-weeks ($p < .05$). By contrast, affective judgments predicted intention at 6-weeks ($p < .05$), but not at baseline or in the residual change model ($p > .05$). Finally, the affective response during exercise had a significant indirect effect on MVPA through intention at 6-weeks ($\beta = .09$; 95% CI .03 to .16) and 12-weeks ($\beta = .08$; 95% CI .03 to .15), though this effect was not significant in the residual change models (see Supplemental Figure 1). Interestingly, unlike the affective response during exercise, affective judgments did not have an indirect effect through intention on MVPA at 6-weeks ($\beta = .05$; 95% CI -.03 to .14) or 12-weeks ($\beta = .07$; 95% CI .00 to .18). Past MVPA did not moderate the effect of the affective response during exercise on intention or future MVPA in the baseline to 6-weeks or 6 to 12-weeks models (see Supplemental Table 1).

Affective response post-exercise.

Figure 2a details the path model for affective judgments, the affective response after exercise, and intention at baseline predicting MVPA at six weeks, and Figure 2b highlights the path model for affective judgments and intention at six weeks, and the affective response after exercise at baseline, predicting MVPA at 12 weeks. Similar to the results of the affective response during exercise, comparable models are presented with unstandardized residuals in Supplemental Figure 2

that involve the prediction of *change* in physical activity (over 6- and 12-weeks). Prediction results with intention and affective judgments are similar to Figure 1 (and Supplementary Figure 1) so only the affective response after exercise variable is highlighted below.

The affective response after exercise did not show direct effects on MVPA after controlling for intention ($p > .73$). However, it was a significant predictor of intention at baseline ($p < .05$), and this indirect effect on MVPA via intention at 6-weeks was meaningful ($\beta = .08$; 95% CI .02 to .16). The affective response after exercise did not predict intention at six weeks, change in intention from baseline to 6-weeks, or show an indirect effect on change in MVPA from baseline to 6-weeks. Past MVPA did not moderate the effect of the affective response post-exercise on intention or future MVPA in the baseline to 6-weeks or 6 to 12-weeks models (see Supplemental Table 1).

Affective response during to post-exercise

We also explored whether the affective response from during to post exercise (residual) predicted intention or MVPA (see Supplemental Figure 3). There were no significant effects when using this variable.

Discussion

Promotion of MVPA among women during the early postpartum period is important because parenting demands may compromise their ability to engage in MVPA and, in turn, hinder the pursuit of longstanding active lifestyles (12). However, affect-related constructs are also key predictors of MVPA (22), and so the physical recovery process during postpartum may also determine activity participation because of how it feels (e.g., good to move vs. uncomfortable, painful) (43). The purpose of this secondary analysis study was to examine two affect-related constructs, the affective response to exercise and affective judgments, as predictors of MVPA intention and behavior among a sample of new mothers (with baseline assessments at 2 months

postpartum and follow-ups at 6- and 12-weeks after baseline) who participated in a randomized trial.

Based on the AHBF (27), we hypothesized that both the affective response during exercise and affective judgments about MVPA would predict future MVPA independently. We had mixed support for this hypothesis. The bivariate relationship between MVPA and both affective judgments and affective response was small ($r = 0.10$ to $r = 0.15$) and nonsignificant, thus neither construct was a meaningful direct predictor of MVPA at six or 12 weeks. These relationships with MVPA are smaller than overall estimates previously reported for affective judgments (41) and the affective response during exercise (35). It may be due to the heavy impact that instrumental (e.g., decisions about immediate priorities), perceived control (e.g., child care duties), and regulatory (e.g., excessive planning) related factors have on MVPA during the postpartum period (7), that may obfuscate any potential determination from affect-related constructs in the first place.

It was noteworthy that the affective response to exercise (whether during or after) had no association with affective judgments, supporting the AHBF framework that considers these as distinct constructs. This sample of new mothers, however, reported a much smaller (and nonsignificant) association than prior research with adult and student populations, where these constructs are typically related to each other in the medium effect size range (35). The deviation may be unique to the postpartum experience, particularly among first-time mothers, where recovery from body changes increases the distinction between how a bout of moderate physical activity feels and forecasted experiences about whether MVPA participation will be enjoyable in the future (43); however, follow-up qualitative research is likely needed to fully understand this matter.

As a further test of the AHBF, we hypothesized that affective judgments would predict MVPA through intention, yet the affective response during exercise would predict MVPA independent of intention, commensurate with theorizing that affective judgments are cognitively

processed affect that is developed into an expectation of an outcome and then intended action (27), while the affective response to exercise is a more automatic type of motivation via a learned hedonic response (30, 65). We found no evidence for this assertion in these data. Specifically, the affective response during exercise was significantly associated with intention, and change in intention, across both 6- and 12-week epochs. It had no direct effect on MVPA after controlling for intention, yet it had a small indirect effect on future MVPA through intention. Affective judgments also had an effect on intention while controlling for the affective response (and no direct effect on MVPA), although this effect did not manifest as an indirect effect on future MVPA via intention. Thus, our results indicated that women in the mid postpartum period (e.g., two to 5 months after delivery) took both their affective judgments and their affective response during exercise into account within the formulation of their intentions toward future MVPA. This illustrates the importance of targeting these constructs for physical activity promotion during this critical and rapidly changing period of time for many women.

The results for affective judgments align with social cognitive theories, where expectations of outcome are thought to determine behavior mainly through intentions (15, 34). The results showing that affective response during exercise predicted MVPA through intention aligns with theorizing by Baumeister and colleagues (44), who suggested that most of our affective responses to stimuli will shape future behavior through cognitive reflection and expectation, such as intention. From an applied perspective, the results highlight the importance of prescribing self-paced physical activity (38, 39) with an emphasis for women on feeling pleasant and enjoying activities during the postpartum period.

It was also interesting to note that mothers' affective response to exercise was a stronger predictor of intention (and MVPA via intention) than affective judgments. This might be due to issues in accurate affective forecasting about physical activity (66) following the changes from

before pre-pregnancy to postpartum. Specifically, the changes to the MVPA experience (e.g., is it now less pleasant because it is rushed? is it now less enjoyable because it is competing with other important childcare duties?) may not be fully accounted for in affective judgments in early postpartum, leading to inaccuracies in future behavioral prediction. There was some evidence for this potential phenomenon because baseline (assessment at 2 months postpartum) affective judgments was not a predictor of intention, yet affective judgments at 6- weeks after baseline did predict intention. This phenomenon of response shift due to a more fulsome understanding of task demands is a common limitation of measurement (67), and may have been present in this trial.

Based on past research (35), we hypothesized that the affective response post-exercise would not be as reliable a predictor of future MVPA compared to the affective response during a bout of exercise. This had mixed support. As noted previously, the affective response during exercise had a meaningful indirect effect on MVPA through intention at six and 12 weeks. The affective response post exercise did have a meaningful indirect effect on MVPA via intention at baseline to 6-weeks, but not at 12-weeks. Bivariate associations between MVPA and the affective response, also showed that when affective responses were assessed during exercise these relations ($r = .13$ to $r = .15$) were in the small effect size range while when affective responses were assessed post-exercise these relations were in the trivial effect size range ($r = .06$ to $r = .07$). Still, these differences are subtle. Rhodes and Kates' prior review on this matter highlighted that the affective response during exercise tends to be a more reliable predictor of behavior than the affective response after exercise and our findings tend to mimic this result. From a theoretical perspective, this effect is likely from the temporal ordering of the these stimuli and how it effects performance motivation (i.e., one must first accomplish MVPA before experiencing post MVPA affect) (27). From an applied perspective, priority attention should be placed on promoting strategies such as

self-regulation and mindfulness that optimize how one feels *during* a bout of exercise over how one feels *after* exercise.

Finally, our study advanced upon previous research that has shown a basic bivariate association between past MVPA and the affective response (46), by exploring whether past MVPA moderated the association between the affective response to exercise and intention and future MVPA. We hypothesized that synergy (high past behavior, positive affective response) between past MVPA and subsequent affective response to exercise may better predict intention and MVPA, but this was not supported in any of our tests. Thus, the effects of the affective response on intention and MVPA does not appear to interact with underlying past behavior.

Despite the novel findings in our study and the strong methods employed, there are noteworthy limitations. First, we were reliant on self-reported MVPA as an outcome. Self-report measures are likely to overestimate MVPA and may suffer from errors in recollection and social desirability (68). Further, our assessment of baseline MVPA does not include behavior during pregnancy, or any immediate post-partum changes in lifestyle. Second, our measures of the affective response to exercise were taken only once, at baseline assessment, and thus have some disadvantage in temporal prediction of 12-week MVPA compared to affective judgments and intention, which were also assessed at 6- weeks. This assessment was also based on a lab-based treadmill test which may not generalize to an affective response to physical activity in another setting (e.g., outdoors) or mode (e.g., biking, resistance training), which served as the outcome measure. Gathering affective response measurements in more natural environments and across different modes of MVPA, perhaps using ecological momentary assessment techniques (69) may yield different findings. Third, the sample of mothers in this study was mainly white, middle income, and university educated. While many of these features do represent the study setting (70), the generalizability to people residing in other regions in Canada or worldwide is unknown. Finally,

affective judgments and the affective response to physical activity are central indicators of processed affect and core affect in the AHBF, yet the framework also includes the roles of other potential indicators of these constructs and incidental affect, which were not included in our model. A full test of this model has never been performed and this would be an innovative approach forward for future research.

In summary, despite the many short- and long-term health benefits conferred by regular MVPA to postpartum mothers, participation is often low so understanding the predictors of participation during early motherhood is important to improve promotion efforts. Considerable attention has been placed on external control-based factors that limit postpartum MVPA (e.g., time commitments from child care demands), and affect-related constructs, which are key predictors of MVPA generally, have seen limited research attention in this population. These data showed that the affective response during exercise was a significant predictor of intention toward future MVPA and had an indirect effect with MVPA via intention at 6- and 12-weeks. By contrast, while affective judgments predicted intention at six weeks ($p < .05$), it was not a significant correlate of intention at baseline or downstream MVPA. These findings show some discrepancies with prior research in adult populations, particularly the lower predictive value of affective judgments, that may highlight some unique promotion needs in postpartum populations. Interventions for women in the postpartum period targeting the affective response *during exercise* may be important to consider, perhaps through self-paced physical activity guidance, mindfulness, self-regulation, and/or encouragement/support. By contrast, affective judgments may not provide accurate information about MVPA motivation during the early postpartum period, potentially from unanticipated changes to the physical activity experience that have not been taken into consideration within the affective forecasting process of new mothers.

Figure Captions

Figure 1. Affective Judgments and the Affective Response During Exercise as Predictors of Intention and Physical Activity A) 6 Weeks and B) 12 weeks Later. Note: Baseline was measured at 2-months postpartum and the follow-ups were obtained at 6- and 12-weeks after baseline.

Figure 2. Affective Judgments and the Affective Response After Exercise as Predictors of Intention and Physical Activity A) 6 Weeks and B) 12 weeks Later. Note: Baseline was measured at 2-months postpartum and the follow-ups were obtained at 6- and 12-weeks after baseline.

References

1. Rhodes RE, Bredin SSD, Janssen I, Warburton DER, Bauman A: Physical activity: Health impact, prevalence, correlates and interventions. *Psychol Health*. 2017, 32:942-975.
2. Warburton DER, Bredin SSD: Health benefits of physical activity: a systematic review of current systematic reviews. *Curr Opin Cardiol*. 2017, 32:541-556.
3. Guthold R, Stevens G, Riley L, Bull F: Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants. *Lancet*. 2018, 6:e1077-1086.
4. Clarke J, Colley R, Janssen I, Tremblay MS: Accelerometer-measured moderate-to-vigorous physical activity of Canadian adults, 2007 to 2017. *Health Rep*. 2019, 30:3-10.
5. Bø K, Artal R, Barakat R, et al.: Exercise and pregnancy in recreational and elite athletes: 2016/17 evidence summary from the IOC Expert Group Meeting, Lausanne Part 3—exercise in the postpartum period. *Br J Sports Med*. 2017, 51:1516–1525.
6. Rhodes RE, Quinlan A: Predictors of physical activity change in observational designs. *Sports Med*. 2015, 45:423-441.
7. Abbasi M, van den Akker O: A systematic review of changes in women's physical activity before and during pregnancy and the postnatal period. *J Reprod Infant Psychol*. 2015, 33:325–358.
8. Davenport MH, Giroux I, Sopper MM, Mottola MF: Postpartum exercise regardless of intensity improves chronic disease risk factors. *Med Sci Sports Exerc*. 2011, 43:951–958.
9. Dipietro L, Evenson KR, Bloodgood B, et al.: Benefits of physical activity during pregnancy and postpartum: An umbrella review. *Med Sci Sports Exerc*. 2019, 51:1292–1302.

10. McIntyre CA, Rhodes RE: Correlates of physical activity during the transition to motherhood. *Women Health*. 2009, 49:66-83.
11. Yao CA, Rhodes RE: Parental correlates in child and adolescent physical activity: A meta-analysis. *Int J Behav Nutr Phys Act*. 2015, 12:10.
12. Bellows-Riecken KH, Rhodes RE: A birth of inactivity? A review of physical activity and parenthood. *Prev Med*. 2008, 46:99-110.
13. Burton C, Doyle E, Humber K, et al.: The biopsychosocial barriers and enablers to being physically active following childbirth: A systematic literature review. *Phys Ther Rev*. 2019, 24:143–155.
14. Ajzen I: The theory of planned behavior. *Organ Behav Hum Decis Process*. 1991, 50:179-211.
15. Bandura A: Health promotion from the perspective of social cognitive theory. *Psychol Health*. 1998, 13:623-649.
16. Rhodes RE, Blanchard CM, Benoit C, et al.: Belief-Level Markers of Physical Activity among Young Adult Couples: Comparisons across Couples without Children and New Parents. *Psychol Health*. 2014, 29:1320-1340.
17. Cowie E, White K, Hamilton K: Physical activity and parents of very young children: The role of beliefs and social-cognitive factors. *Br J Health Psychol*. 2018, 23:782-803.
18. Mailey EL, McAuley E: Impact of a brief intervention on physical activity and social cognitive determinants among working mothers: a randomized trial. *J Behav Med*. 2014, 37:343-355.
19. Dlugonski D, Motl RW: Social cognitive correlates of physical activity among single mothers with young children. *Psychol Sport Exerc*. 2014, 15:637-641.
20. Gilinsky AS, Dale H, Robinson C, et al.: Efficacy of physical activity interventions in post-natal populations: Systematic review, meta-analysis and content coding of behaviour change techniques. *Health Psychol Rev*. 2015, 9:244-263.
21. Lim S, Hill B, Pirotta S, O'Reilly S, Moran L: What are the most effective behavioural strategies in changing postpartum women's physical activity and healthy eating behaviours? A systematic review and meta-analysis. *J Clin Med*. 2020, 9:237.
22. Williams DM, Rhodes RE, Conner MT: Conceptualizing and intervening on affective determinants of health behaviour. *Psychol Health*. 2019, 34:1267-1281.

23. Ekkekakis P, Zenko Z: Escape from cognitivism: Exercise as hedonic experience. In M. Raab, P. Wylleman, R. Seiler, A. M. Elbe and A. Hatzigeorgiadis (eds), *Sport and exercise psychology research from theory to practice*. London: Academic, 2016, 389-414.
24. Conroy DE, Berry TR: Automatic affective evaluations of physical activity. *Exerc Sport Sci Rev*. 2017, *45*:230-237.
25. Liao Y, Shonkoff ET, Dunton GF: The acute relationships between affect, physical feeling states, and physical activity in daily life: A review of current evidence. *Front Psychol*. 2015, *6*:1975.
26. Rhodes RE: The evolving understanding of physical activity behavior: A multi-process action control approach. In A. J. Elliot (ed), *Advances in Motivation Science* (Vol. 4). Cambridge, MA: Elsevier Academic Press, 2017, 171-205.
27. Stevens CJ, Baldwin AS, Bryan AD, et al.: Affective determinants of physical activity: A conceptual framework and narrative review. *Front Psychol*. 2020, *11*:568331.
28. Williams DM, Evans DR: Current emotion research in health behavior science. *Emot Rev*. 2014, *6*:282-292.
29. Brand R, Cheval B: Theories to explain exercise motivation and physical inactivity: Ways of expanding our current theoretical perspective. *Front Psychol*. 2019, *21*.
30. Cabanac M: Pleasure: The common currency. *J Theor Biol*. 1992, *155*:173-200.
31. Johnston VS: The origin and function of pleasure. *Cogn Emot*. 2003, *17*:167-179.
32. Williams DM: *Darwinian Hedonism and the Epidemic of Unhealthy Behavior*: Cambridge University Press, 2019.
33. Rhodes RE, Fiala B, Conner M: Affective judgments and physical activity: A review and meta-analysis. *Ann Behav Med*. 2009, *38*:180-204.
34. Fishbein M, Ajzen I: *Predicting and changing behavior: The reasoned action approach*. New York, NY: Psychology Press, 2010.
35. Rhodes RE, Kates A: Can the affective response to exercise predict future motives and physical activity behavior? A systematic review of published evidence. *Ann Behav Med*. 2015, *49*:715-731.
36. Kwan B, Bryan AD: In-task and post-task affective response to exercise: Translating exercise intentions into behaviour. *Br J Health Psychol*. 2010, *15*:115-131.
37. Schneider M, Dunn AL, Cooper D: Affect, exercise, and physical activity among healthy adolescents. *J Sport Exerc Psychol*. 2009, *31*:706-723.

38. Williams DM, Dunsinger S, Ciccolo JT, et al.: Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychol Sport Exerc.* 2008, 9:231-245.
39. Williams DM, Dunsinger S, Jennings EG, Marcus BH: Does affective valence during and immediately following a 10-min walk predict concurrent and future physical activity? *Ann Behav Med.* 2012, 44:43-51.
40. Nasuti G, Rhodes RE: Affective judgment and physical activity in youth: A review and meta-analysis. *Ann Behav Med.* 2013, 45:357-376.
41. Conner M: Theory of planned behavior. In G. Tenenbaum and R. C. Eklund (eds), *Handbook of Sports Psychology (4th Edition)*. Hoboken, NJ: Wiley, 2020, 3-18.
42. Ekkekakis P, Lind E: Exercise does not feel the same when you are overweight: The impact of self-selected and imposed intensity on affect and exertion. *Int J Obes.* 2006, 30:652-660.
43. Doran F, Davis K: Factors that influence physical activity for pregnant and postpartum women and implications for primary care. *Aust J Prim Health.* 2011, 17:79-85.
44. Baumeister RF, Vohs KD, DeWall CN, Zhang L: How emotion shapes behavior: Feedback, anticipation, and reflection, rather than direct causation. *Pers Soc Psychol Rev.* 2007, 11:167-203.
45. Rhodes RE, Blanchard CM, Quinlan A, et al.: Couple-based physical activity planning for new parents: A randomized trial. *Am J Prev Med.* 2021, 61:518-528.
46. Magnan RE, Kwan BM, Bryan AD: Effects of current physical activity on affective response to exercise: Physical and social-cognitive mechanisms. *Psychol Health.* 2013, 28:418-433.
47. Rhodes RE, Beauchamp MR, Quinlan A, et al.: Predicting the physical activity of new parents who participated in a physical activity intervention. *Soc Sci Med.* 2021, 284:114221.
48. Quinlan A, Rhodes RE, Beauchamp MR, et al.: Evaluation of a physical activity intervention for new parents: Protocol paper for a randomized trial. *BMC Public Health.* 2017, 17:875.
49. Schulz KF, Altman DG, Moher D, CONSORT Group: CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. *Ann Intern Med.* 2010, 152:e24.
50. Rhodes RE: Multi-process action control in physical activity: A primer. *Front Psychol.* 2021, 12:797484.
51. Warburton DER, Bredin SSD, Jamnik V, Gledhill N: Validation of the PAR-Q+ and ePARmed-X+. *Health Fit J Can.* 2011, 4:38-46.

52. Godin G, Jobin J, Bouillon J: Assessment of leisure time exercise behavior by self-report: A concurrent validity study. *Can J Public Health*. 1986, 77:359-361.
53. Godin G, Shephard RJ: A simple method to assess exercise behavior in the community. *Can J Appl Sport Sci*. 1985, 10:141-146.
54. Craig CL, Marshall AL, Sjoström M, et al.: International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sport Exerc*. 2003, 35:1381-1395.
55. Courneya KS, Jones LW, Rhodes RE, Blanchard CM: Effects of different combinations of intensity categories on self-reported exercise. *Res Q Exerc Sport*. 2004, 75:429-433.
56. Healthy Pregnancy BC: I've Had my Baby. How can I fit in exercise when I have a new baby to care for? , 2014.
57. Rhodes RE, Rebar A: Conceptualizing and defining the intention construct for future physical activity research. *Exerc Sport Sci Rev*. 2017, 45:209-216.
58. Rejeski WJ, Best D, Griffith P, Kenney E: Sex-role orientation and the responses of men to exercise stress. *Res Q Exerc Sport*. 1987, 58:260-264.
59. Quinlan A, Rhodes RE, Blanchard CM, Naylor PJ, Warburton DER: Family planning to promote physical activity: A randomized controlled trial protocol. *BMC Public Health*. 2015, 15: 1-9.
60. Ebbeling CB, Ward A, Puleo EM, Widrick J, Rippe JM: Development of a single-stage walking treadmill test. *Med Sci Sport Exerc*. 1991, 23:966-973.
61. Rhodes RE, Courneya KS: Modelling the theory of planned behaviour and past behaviour. *Psychol Health Med*. 2003, 8:57-69.
62. Hayes AF: *Introduction to mediation, moderation, and conditional process analysis: Regression-based approach*. New York: Guilford Press, 2013.
63. Tremblay MS, Warburton DER, Janssen I, et al.: New physical activity guidelines for Canadians. *Appl Physiol Nutr Metab*. 2011, 36:36-46.
64. Faul F, Buchner A, Erdfelder E, Lang AG: G*Power. Kiel, Germany, 2009.
65. Williams DM, Rhodes RE, Conner M: Overview of affective determinants of health behavior. In D. M. Williams, M. Conner and R. E. Rhodes (eds), *Affective Determinants of Health Behavior*. New York: Oxford Press, 2018, 1-18.
66. Gilbert DT, Ebert JET: Decisions and revisions: The affective forecasting of changeable outcomes. *J Pers Soc Psychol*. 2002, 82:503-514.

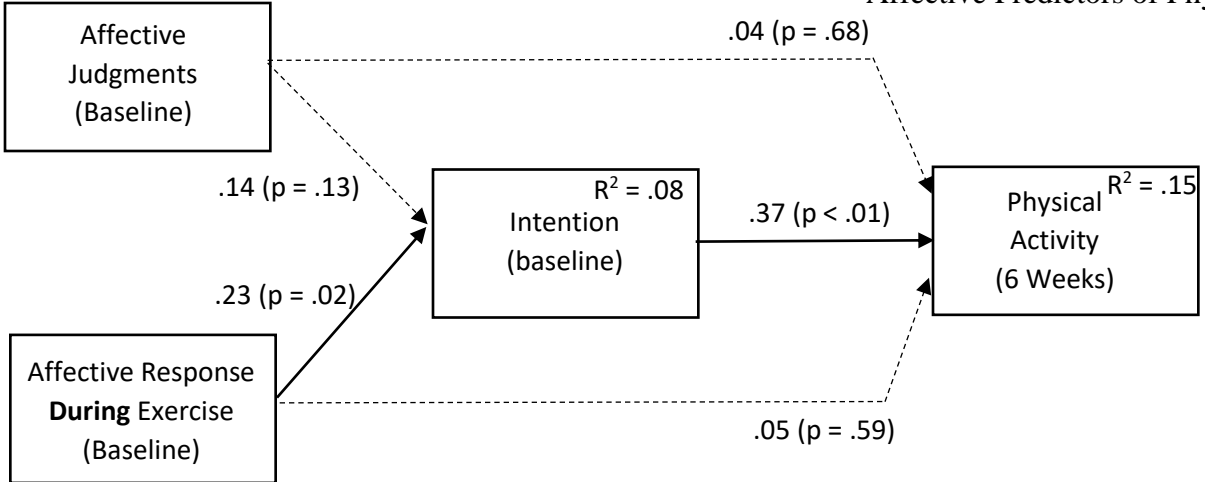
67. Campbell DT: Factors relevant to the validity of experiments in social settings. *Psychol Bull.* 1957, 54:297-312.
68. Prince SA, Adamo KB, Hamel ME, et al.: A comparison of direct versus self-report measures for assessing physical activity in adults: A systematic review. *Int J Behav Nutr Phys Act.* 2008, 5:doi:10.1186/1479-5868-1185-1156.
69. Dunton GF: Ecological momentary assessment in physical activity research. *Exerc Sport Sci Rev.* 2017, 45:48-54.
70. Statistics Canada: Census Profile, 2016 Census Victoria [Census metropolitan area], British Columbia a [Province]. 2017.

Table 1
Correlations among Affect Constructs and Intention with Moderate to Vigorous Intensity Physical Activity (N = 105)

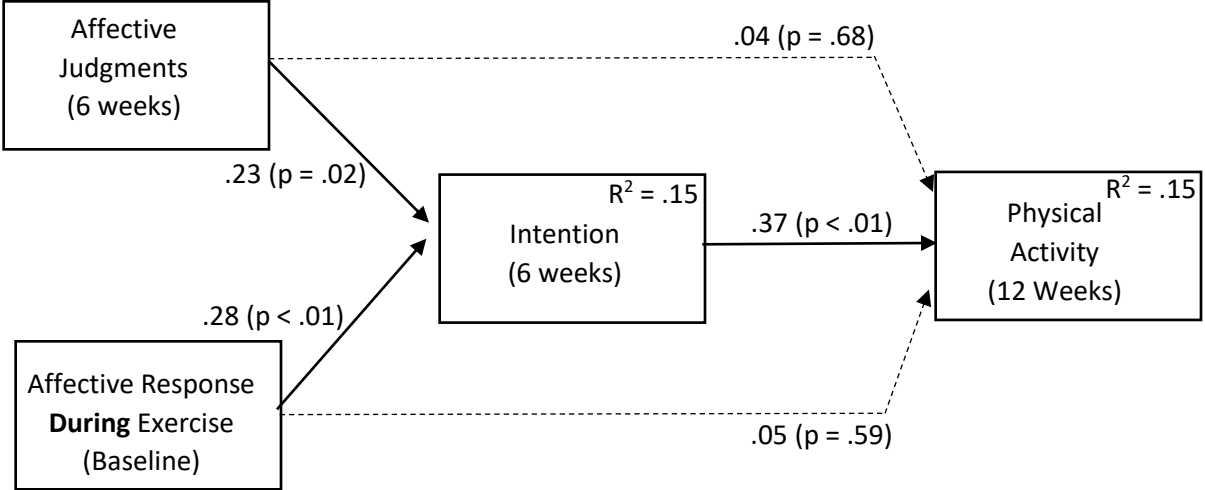
	2	3	4	5	6	7	8	9	M	SD
1. Affective Judgments (Baseline)	.06 (.55)	.13 (.20)	.15 (.13)	.19 (.03)	.10 (.26)	.38 (<.01)	.27 (<.01)	.08 (.38)	4.35	0.71
2. Affective Response During PA (Baseline)	.66 (<.01)	-.15 (.14)	.24 (.01)	.15 (.14)	.16 (.09)	.31 (<.01)	.13 (.18)		0.13	0.86
3. Affective Response After PA (Baseline)		.64 (<.01)	.23 (.02)	.07 (.51)	.12 (.21)	.17 (.08)	.06 (.55)		0.15	0.87
4. Affective Response During-to-After PA (Baseline)				.09 (.35)	-.13 (.19)	.02 (.87)	-.12 (.22)	-.11 (.28)	0.04	0.65
5. Intention (Baseline)					.39 (<.01)	.30 (<.01)	.42 (<.01)	.22 (.01)	4.26	0.72
6. PA (6 Weeks after Baseline)					.24 (<.01)	.38 (<.01)	.63 (<.01)		205.05	149.57
7. Affective Judgments (6 Weeks after Baseline)						.29 (<.01)	.11 (.21)		4.38	0.61
8. Intention (6 Weeks After Baseline)							.31 (<.01)		4.00	0.71
9. PA (12 Weeks After Baseline)									206.57	163.12

Note: p levels are provided in parentheses below the correlation coefficients.

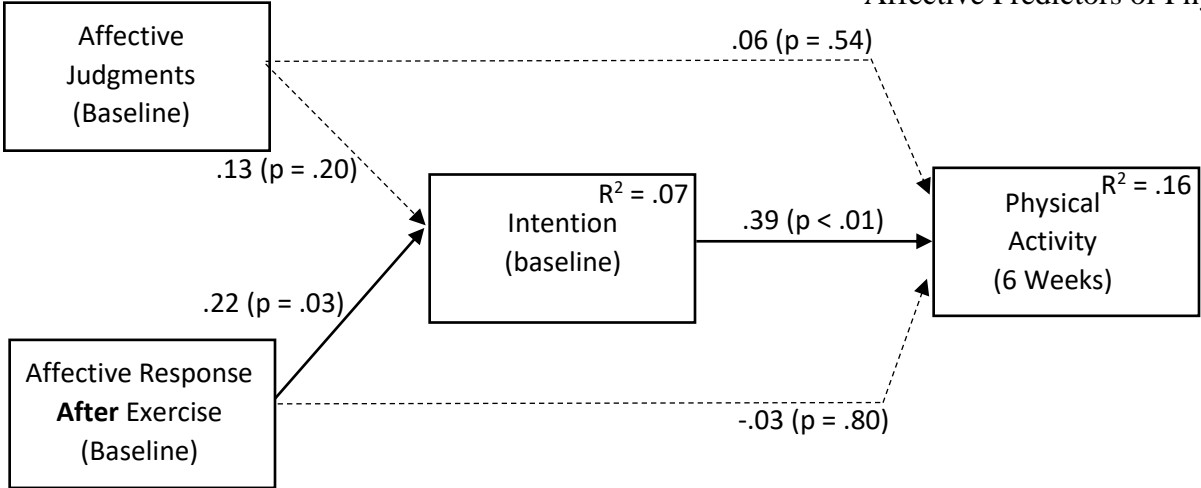
A)



B)



A)



B)

