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# Using a combined protection motivation theory and health action process approach intervention to promote exercise during pregnancy

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**Abstract** Despite the benefits of exercise during pregnancy, many expectant mothers are inactive. This study examined whether augmenting a protection motivation theory (PMT) intervention with a Health Action Process Approach can enhance exercise behavior change among pregnant women. Sixty inactive pregnant women were randomly assigned to one of three treatment groups: PMT-only, PMT + action-planning, and PMT + action-and-coping-planning. Week-long objective (accelerometer) and subjective (self-report) exercise measures were collected at baseline, and at 1- and 4-weeks post-intervention. Repeated-measures ANOVAs demonstrated that while all participants reported increased exercise from baseline to 1-week post-intervention, participants in both planning groups were significantly more active ($p < .001$) than those in the PMT-only group by 4-weeks post-intervention ($\eta^2 = .13$ and .15 for accelerometer and self-report data, respectively). In conclusion, augmenting a PMT intervention with action or action-and-coping-planning can enhance exercise behavior change in pregnant women.

**Keywords** Pregnancy · Exercise · Intervention · Health action process approach · Protective motivation theory

## Introduction

Exercise is associated with numerous benefits across the lifespan including a reduced risk of cardiovascular disease, diabetes, cancer, hypertension, obesity, depression, and osteoporosis (cf., Warburton et al., 2006). During pregnancy, regular exercise improves or maintains cardiovascular fitness, helps manage pregnancy-related musculoskeletal issues, improves sleep, positively impacts mental health, as well as reduces the risk of two serious maternal-fetal conditions: gestational diabetes and pre-eclampsia (Lewis et al., 2008; Pivarnik et al., 2006). Given these benefits, Canadian guidelines recommend that all healthy pregnant women exercise for 30 min at a moderate intensity on 3–4 days of the week (Davies et al., 2003). Despite these recommendations, fewer than 30 % of pregnant women are sufficiently active (Gaston & Cramp, 2011), highlighting the need for more research aimed at understanding the factors associated with exercise initiation and maintenance during pregnancy.

Protection motivation theory (PMT; Rogers, 1975) represents a useful social cognitive model of individuals' motivation to engage in protective behaviors. According to PMT, four factors combine to predict an individual's intention to engage in a particular behavior: perceived severity of a threat (e.g., negative health consequences of inactivity), perceived vulnerability to the threat, perceived efficacy of the preventive behavior (response efficacy; e.g., the effectiveness of exercise in improving health), and perceived self-efficacy, or confidence in one's ability to perform the recommended behavior (e.g., confidence in engaging in sufficient amounts of exercise to reap health benefits). Intention then serves as the precursor to behavior. Numerous studies have used PMT to predict and understand health-related behaviors (e.g., safe sex practices, tooth flossing, drinking, breast-cancer screening, workplace safety, sunscreen use, exercise, etc.) in a variety of populations (e.g., high school and university students, homosexual men, older women, parents of disabled children, men exposed to workplace hazards, general adult population, etc.) and meta-analytic results have supported the

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usefulness of all four PMT constructs for predicting behavioral intention (Milne et al., 2000).

Given the protective benefits of exercise during pregnancy (e.g., reduced risk of gestational diabetes and preeclampsia), it is not surprising that an information-based intervention designed to target PMT constructs was effective in manipulating pregnant women's exercise intention and bringing about initial behavior change (Gaston & Prapavessis, 2009). Using a print-based intervention, Gaston and Prapavessis randomly assigned pregnant women into one of three conditions: PMT, attention control, and non-contact control. PMT variables, goal intention, action planning, and follow up behavior at 1-week post-intervention were assessed. Results indicated that women who were assigned to the PMT-present group reported significantly greater exercise goal intention as well as behavior at follow-up. Even though implementation intention (i.e., action planning) did not differ significantly between groups, regression analyses revealed that this variable was an important predictor of follow-up behavior.

Despite their promising results, the authors identify two major limitations: (a) their failure to deliver an engaging action planning intervention which may have manipulated this variable and (b) their short term and self-report behavior outcome measure. These are legitimate concerns given the relation which emerged between action planning and behavior coupled with evidence that PMT, not unlike numerous other theories, fails to account for behavior change as successfully as it accounts for intention change irrespective of the population studied (cf. Milne et al., 2000; Webb & Sheeran, 2006). For example, in a meta-analysis 47 studies examining the relation between intention and health behaviors using a variety of populations, Webb and Sheeran showed that a medium-to-large change in intention ($d = 0.66$) led to only a small-to-medium change in behavior ($d = 0.36$). These results highlight the existence of an 'intention–behavior gap' and the fact that changing complex behaviors such as physical inactivity requires more than simply the formation of good intentions (Schwarzer, 2008).

One model which has shown promise in recent behavior change research, however, is the Health Action Process Approach (HAPA; Schwarzer, 1992, 2008). According to the HAPA model, successful behavior change involves both a pre-intentional motivational phase in which intention is formed and a post-intentional volitional phase in which intention is translated into action. To this end, the HAPA attempts to bridge the afore-alluded-to 'intention–behavior gap' with an individualized and engaging action and coping planning component. 'Action planning' stems from Gollwitzer's (1999) seminal work on implementation intentions. In this paper, Gollwitzer cites numerous studies which demonstrate that individuals who identifying how, when, where, with whom and for how long they would perform the target behavior are more likely to follow through on their intentions compared to their counterparts who had not formulated such plans. The populations and behaviors studied included undergraduate students asked to prepare a school project over the Christmas holidays, women asked to perform breast self-examinations, adults asked to take a vitamin supplement or eat more healthily, and college students and older adults asked to increase their exercise participation. According to Gollwitzer, implementation intentions, or action plans, link goal-directed behaviors such as exercise to specified environmental stimuli in order to elicit the desired responses automatically. In a meta-analysis of 94 studies, Gollwitzer and Sheeran (2006) demonstrated that implementation intentions had a positive medium-to-large effect ($d = +.65$) on goal achievement in a variety of domains (e.g., consumer goals, academic goals, environmental goals, health goals, etc.) and among a variety of populations. Furthermore, Gollwitzer postulates that in addition to forming implementation intentions, individuals who pre-decide 'how to best escape…unwanted influences on behavior' (p. 494) will be able to act on their intentions even in the face of barriers. This anticipation of barriers and formulation of coping strategies is referred to as 'coping planning' and is assumed to enhance the effects of action planning on behavior change. For example, in a study of cardiac rehabilitation patients, Scholz et al. (2007) found that coping planning partially mediated the effects of an exercise intervention.

Within the exercise domain, studies using an undergraduate population have attempted to integrate volitional strategies (i.e., action/coping planning) with motivational strategies based on other social cognitive behavior change models (e.g., Milne et al., 2002; Prestwich et al., 2003). A core argument for theory integration is that a greater understanding can be gained through the joint use of complementary theory than through the use of a single model approach (Brawley, 1993; Maddux, 1993). With respect to PMT, previous research has demonstrated that augmenting an intervention designed to manipulate PMT variables (i.e., perceived severity, perceived vulnerability, response efficacy, and self-efficacy) with action planning (Milne et al., 2002) or action and coping planning (Zhang & Cooke, 2011) can lead to greater increases in self-reported exercise among undergraduate students. However, the interplay between motivational and volitional strategies for exercise has never been explored among pregnant women.

Using a 3-group randomized control trial design, the purpose of this study was to examine whether combining an information-based motivational intervention targeting PMT variables with an action planning or action and coping planning volitional intervention based on HAPA can enhance exercise behavior change among pregnant women compared to the PMT-based intervention alone. The three groups were: (1) PMT-only (i.e., PMT-based intervention alone); (2) action planning (i.e., PMT-based intervention plus action planning); and (3) combined planning (PMT-based intervention plus action and coping planning). The present study design was chosen for its ability to isolate and evaluate individual intervention components in order to enhance our understanding of the mechanisms of change associated with exercise behavior in this population. According to Michie et al. (2005) and Abraham and Michie (2008), understanding which particular techniques or combinations of techniques enhance behavior change intervention effectiveness is crucial for successful replication and adoption. In line with these recommendations, the present study design will enable specific conclusions to be drawn regarding the unique role that action planning and action-and-coping-planning play—or do not play—when it comes to exercise behavior change among pregnant women.

Successful leisure-time exercise behavior change was the main outcome of interest and it was hypothesized that: (a) participants in all three groups will demonstrate an increase in objectively measured 30-min bouts and self-reported leisure time exercise behavior from baseline to 1-week post-intervention, (b) at 4-weeks post-intervention, participants in both planning groups will demonstrate significantly higher exercise levels compared to those in the PMT-only group, and participants in the combined planning group will also demonstrate significantly higher exercise levels compared to those in the action-planning-only group. These hypotheses were based on the following rationale. First, previous research has demonstrated that an information-based intervention designed to target PMT variables can serve as an effective intervention strategy for *short-term* exercise behavior change, but is unlikely to lead to sustained behavior past 1- or 2-weeks post-intervention (Gaston & Prapavessis, 2009; Graham et al., 2006). Second, in accordance with previous research, we anticipated that the addition of action planning would enhance exercise behavior change compared to an intervention targeting PMT variables only (Prestwich et al., 2003; Milne et al., 2002; Zhang & Cooke, 2011). Furthermore, the expectation that the addition of coping planning would be more effective than action planning alone is in line with previous research demonstrating that action and coping planning can lead to higher levels of exercise among cardiac rehabilitation patients compared to action planning alone (Sniehotta et al., 2006).

## Method

### Participants and power calculation

The final sample consisted of sixty pregnant women from Ontario, Canada, who were recruited between May 2010 and April 2011. Participants were recruited through a posting on an online Ontario-based parenting newsgroup ($n = 36$), an article in a weekly community newspaper ($n = 6$), or a midwifery clinic which agreed to pass out recruitment materials ($n = 18$). Women were verbally told that they were eligible to participate provided they were between 13 and 31 weeks pregnant, participated in fewer than three weekly exercise sessions, and had not been advised by their doctor to avoid exercise. Women in the first trimester of pregnancy were excluded based on recommendations that inactive women wait until the second trimester before starting an exercise program (Davies et al., 2003), and the upper cut-point of 31 weeks was chosen to ensure that women completed the study prior to their delivery date. Seventy-one women contacted the primary investigator and 11 were ineligible due to being in the first trimester or past 31 weeks or already meeting exercise guidelines. All relevant demographic characteristics are presented by group in Table 1.

The a priori sample size calculation took into account the large effect size ($\eta^2 = .30$) obtained by Gaston and Prapavessis (2009) and the medium-large effect size ($\eta^2 = .11$) obtained by Zhang and Cooke (2011) in their studies combining PMT-based information and action and coping planning. Based on these results, approximately 20 participants were needed per group for a between-group design with an $\alpha$ level of .05 and a power of .80 (Cohen, 1992).

### *Intervention*

Depending upon group assignment (see "Procedure" section and Fig. 1 for design overview), participants received two or more of the following intervention components. The information which follows is in line with intervention reporting guidelines such as those recommended by Davidson et al. (2003) and the CONSORT statement (Moher et al., 2001).

### *PMT material (25 min)*

Microsoft® PowerPoint software (Microsoft Office, 2007) was used to create an intervention slide show entitled *Exercise during pregnancy*. The slide show aimed to educate women about the benefits of exercise during pregnancy, outline the Canadian guidelines for exercise during pregnancy, provide safe and effective exercise suggestions and discuss safety considerations. A slide show was chosen for several reasons, including cost efficiency (i.e., did not require the printing of materials or handouts), and the ability to present a standardized intervention to all participants.

**Table 1** Demographic characteristics for the three treatment conditions

| Variable | PMT ($n = 20$) | AP ($n = 21$) | AP&CP ($n = 19$) | Statistic | $p$ level |
|---|---|---|---|---|---|
| Age in years (SD) | 31.75 (4.68) | 29.10 (4.75) | 31.21 (4.50) | $F(2, 57) = 1.87$ | .16 |
| BMI | 28.50 (4.01) | 26.49 (4.53) | 28.39 (5.98) | $F(2, 57) = 1.09$ | .34 |
| Weeks pregnant (SD) | 21.20 (5.50) | 22.62 (5.20) | 23.29 (5.19) | $F(2, 57) = .80$ | .46 |
| Pregnancy status | | | | | |
| First pregnancy | 35.0 % | 42.9 % | 42.1 % | $\chi^2(2, N = 60) = .32$ | .85 |
| Second or subsequent | 65.0 % | 57.1 % | 57.9 % | | |
| Ethnicity | | | | | |
| Caucasian | 90.0 % | 90.5 % | 89.5 % | $\chi^2(6, N = 60) = 3.01$ | .81 |
| Other (African American, Aboriginal, or Asian) | 10.0 % | 9.5 % | 10.5 % | | |
| Marital status | | | | | |
| Married/common-law | 100.0 % | 100.0 % | 100.0 % | | |
| Single/separated | 0.0 % | 0.0 % | 0.0 % | | |
| Annual household income | | | | | |
| Under $25,000 | 10.0 % | 4.8 % | 0.0 % | $\chi^2(12, N = 60) = 18.79$ | .09 |
| $25,000–$40,000 | 15.0 % | 14.3 % | 10.5 % | | |
| $40,000–$60,000 | 10.0 % | 23.8 % | 15.8 % | | |
| $60,000–$80,000 | 20.0 % | 0.0 % | 47.4 % | | |
| $80,000–$100,000 | 15.0 % | 14.3 % | 10.5 % | | |
| $100,000–$150,000 | 15.0 % | 33.3 % | 15.8 % | | |
| Prefer not to answer | 15.0 % | 9.5 % | 10.5 % | | |
| Employment status | | | | | |
| Employed full time | 35.0 % | 28.6 % | 47.4 % | $\chi^2(8, N = 60) = 11.01$ | .20 |
| Employed part time | 20.0 % | 33.3 % | 0.0 % | | |
| Stay at home mother | 45.0 % | 28.6 % | 47.4 % | | |
| Other (student/self-employed) | 0.0 % | 9.6 % | 5.3 % | | |
| Education level achieved | | | | | |
| Graduate degree | 5.0 % | 23.8 % | 10.5 % | $\chi^2(8, N = 60) = 10.68$ | .22 |
| Bachelors | 25.0 % | 38.1 % | 42.1 % | | |
| College/technical training | 60.0 % | 23.8 % | 26.3 % | | |
| Secondary school diploma | 10.0 % | 14.3 % | 15.8 % | | |
| Baseline physical activity | | | | | |
| 30 min bouts of MVPA | .20 (.41) | .29 (.56) | .58 (.77) | $F(2, 57) = 2.17$ | .12 |
| Raw activity counts (×1,000) | 614.54 (191.05) | 696.95 (295.63) | 687.15 (226.81) | $F(2, 57) = .69$ | .51 |
| Weekly self-report activity score | 9.55 (6.25) | 8.33 (6.46) | 8.32 (7.02) | $F(2, 57) = .23$ | .79 |

Standard deviation presented in parentheses; *AP* action-planning group, *AP&CP* action-and-coping-planning group, *BMI* body mass index [weight(kg)/height(m)$^2$], *PMT* PMT-only group, *MVPA* moderate-vigorous physical activity

Based on previous work (Gaston & Prapavessis, 2009), this component of the intervention was designed to influence the four major PMT constructs using factual information supported by academic references (Davies et al., 2003; Lewis et al., 2008; Weissgerber et al., 2006). The intervention targeted participants' 'perceived vulnerability' beliefs by providing incidence rates for conditions such as gestational diabetes and pre-eclampsia (e.g., "Pre-eclampsia affects approximately 4 % of healthy pregnant women; Weissgerber et al."), and 'perceived severity' by highlighting the seriousness of the condition (e.g., "Apart from abortion, induced labor or caesarian delivery, there is no known cure for pre-eclampsia; Weissgerber et al."). 'Response efficacy' was targeted by providing information regarding the role of exercise in reducing the risk of maternal-fetal disease (e.g., Exercise can significantly reduce the risk of developing pre-eclampsia; Lewis et al., 2008). Finally, a number of different strategies were used to target self-efficacy. According to Bandura (1997), self-efficacy can be enhanced through four major sources of information: verbal persuasion, personal mastery experiences, vicarious experience, and correcting physiological

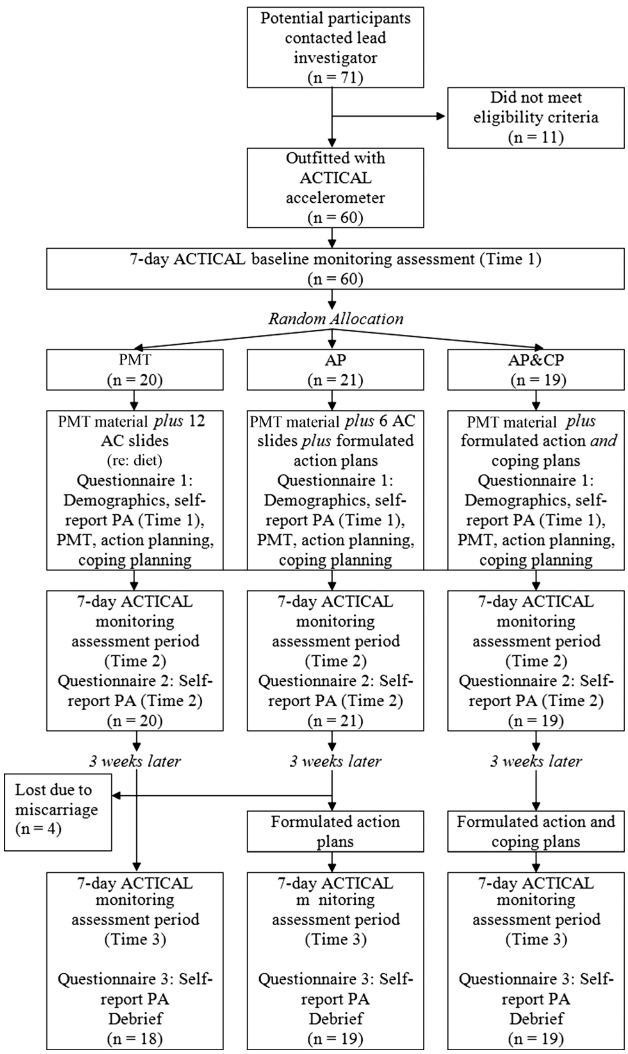


**Fig. 1** Flow diagram of design and overall procedure. *AC* attention control, *AP&CP* action-and-coping-planning group, *AP* action-planning group, *PMT* PMT-only group, *PA* physical activity, *PMT* protection motivation theory

misinterpretations. Verbal persuasion was used to present exercise as achievable (e.g., "Meeting guidelines for physical activity during pregnancy is easy and fun!") and assuring participants that "every little bit counts." Vicarious experience was incorporated into the intervention through the use of photos of 'real' pregnant women engaged in healthy physical activity (i.e., not models), and an attempt to correct misinterpretations of physiological states was made by discussing the physiological changes which accompany pregnancy and how they impact exercise (i.e., "Being short of breath is quite common during pregnancy and not a sign that a woman should not exercise"). By asking participants about their personal exercise experiences and encouraging common activities such as walking, the intervention aimed to foster self-efficacy by drawing upon participants' own past personal mastery experiences.

Finally, the intervention material outlined current Canadian guidelines for exercise during pregnancy (Davies et al., 2003) and described the numerous ways in which they could be met (e.g., walking, swimming, aquafit, and low impact aerobics). Safety considerations (e.g., maintain adequate nutrition, avoid exercise in hot or humid weather) and reasons to stop exercise (e.g., excessive shortness of breath, vaginal bleeding) were also addressed.[1]

### *Attention-control material (20 min)*

Twelve attention-control slides were created featuring information on diet and pregnancy from Canada's Food Guide (Health Canada, 2007). The slides outlined basic information about the importance of proper nutrition during pregnancy and the four food groups (6 slides, 10 min), as well as strategies for increasing fruit and vegetable intake (e.g., keeping a bowl of fresh fruit readily available; 6 slides, 10 min).

### *Action planning intervention (10 min)*

Participants in both the action planning and combined planning groups received a planning sheet and were asked to form five action plans specifying when, where, how, with whom, and for how long they would exercise over the course of the next week.

### *Combined planning intervention (20 min)*

In addition to receiving the action planning intervention described above (10 min), participants in the combined planning group were also asked to anticipate potential barriers and identify ways that they could be overcome (10 min).

The primary investigator conducted the action and combined planning interventions in a non-interfering manner by providing brief instructions and then remaining available to answer any questions. The planning intervention was modeled after previous work (Sniehotta et al. 2006).[2]

## Measures

### *PMT, goal intention, action planning, and coping planning*

All relevant scale details are provided in Table 2.

[1] The intervention material can be obtained by contacting the principal investigator (corresponding author).

[2] Please refer to Sniehotta et al. (2006) for a detailed description of the planning sheets.

**Table 2** Description of scales and psychometric properties

| Variable | Sample items and scale | No. items and alpha | Source |
|---|---|---|---|
| PMT | "It is likely that I will develop health problems at some point during my pregnancy" (PV; 4 items); "I feel that if I were to develop health problems, it would seriously affect me for the rest of my pregnancy" (PS; 4 items); "I feel that the evidence linking physical exercise to health problem reduction is very strong" (RE; 4 items); and "If I wanted to I could easily do the types and amount of physical exercise necessary to reduce my risk of developing health problems during my pregnancy" (SE; 4 items); Scale: 1 (strongly disagree) to 7 (strongly agree) | 16; α = .70–.85 | Gaston and Prapavessis (2009) |
| Goal intention | "Do you plan to start an exercise program over the course of the following week to reduce your risk of health problems during pregnancy?" Scale: 1 (definitely not) to 7 (definitely) | 3; α = .85 | Gaston and Prapavessis |
| Action and coping planning | "I already have concrete plans (when/where/how/how often/with whom) to exercise over the course of the following week" (action Planning); "I already have concrete plans regarding what to do if something intervenes in the next week" (coping planning); Scale: 1 (not at all true) to 4 (exactly true) | 5; α = .95 | Sniehotta et al. (2005) |
| Exercise | "Over the last 7 days, how many times did you do the following kinds of exercise for more than 30 min during your free-time (light/moderate/vigorous)" | 3; NA | Godin and Shepherd (1985) |

*Exercise*

Objective (accelerometer) and self-reported exercise was measured for three distinct 7-day periods: baseline (Time 1), immediately following the intervention (Time 2) and 4 weeks post-intervention (Time 3). All pertinent accelerometer data collection and analytical procedures are described in Table 3. The raw data were analyzed using custom software KineSoft version 3.3.62 (KineSoft, Saskatchewan, Canada) to produce a series of standardized outcome variables similar to the procedures outlined by Esliger et al. (2005). First, leisure time exercise (i.e., purposeful bouts of exercise) was examined by applying cut-points and identifying the number of 30-min bouts of moderate-vigorous physical activity (MVPA). To count as a bout, 30 consecutive minutes of observations had to exceed the moderate intensity cut-point (with a maximum of five observations allowed to fall below the cut-point). Second, total counts per week (which includes all recorded movement) were used to examine changes in overall activity levels. The self-report measure (see Table 2) was used to generate a total weekly activity score for each participant using the following formula: (light × 3) + (moderate × 5) + (vigorous × 9).

## Procedure

Institutional ethics approval (#16217E) was obtained prior to the start of recruitment. After providing informed consent, participants were equipped with an accelerometer and instructed not to change their behavior during the baseline assessment period (Time 1). Written and verbal instructions were provided (see Table 3). Participants kept the monitor for the duration of the study and then returned it either in person or by mail in a prepaid return envelope. Accelerometer wear statistics for all participants are provided in Table 4.

Twenty-four participants lived within driving distance of the investigator and these intervention sessions were conducted in person. The remaining 36 participants received the same intervention via phone and an online presentation website (www.zoho.com). To ensure equal numbers of local and remote participants in all conditions, two computer-generated random numbers lists were created by the lead investigator using an online research randomization program (Urbaniak & Plous, 2008). Upon completion of their 7-day baseline assessment, participants were randomly assigned to one of three experimental groups: PMT-only (PMT + attention-control), action planning (PMT + action planning), or combined planning (PMT + action-and-coping-planning) (see Fig. 1).

The one-on-one intervention session lasted approximately 45 min and was delivered by the principal investigator to ensure standardization between participants. During the first 25 min, the investigator used a predetermined script to guide all participants through the intervention material designed to target PMT constructs described earlier. The remaining 20 min differed between experimental groups: participants in the PMT-only group viewed 12 additional attention-control slides (20 min), participants in the action planning group viewed 6 additional attention-control slides (10 min) plus took part in the action planning intervention (10 min) previously described, and participants in the combined planning group participated in both the action planning and coping planning intervention (20 min). All groups received equal contact time.

At the end of the session, participants completed Questionnaire 1 (demographics, self-report baseline exercise, PMT variables, goal intention, action planning, and coping planning). As a manipulation check participants in both planning groups were required to describe their action (and, if applicable, coping) plans. All questionnaires were completed online via a survey website (SurveyMonkey.com, Palo Alto, CA, USA). Participants then wore the accelerometer for a second 7 day period (Time 2) before completing Questionnaire 2 (self-reported exercise). Participants were then given a start date 3 weeks later when they would be required to start wearing the accelerometer for their final 7-day assessment period (Time 3). Four days prior to the start of their final week, participants in all three groups were contacted by email and reminded of their start date. As planning is an ongoing process, participants in both planning groups were reminded (through a single sentence in the aforementioned email) to formulate another set of action plans at this time while participants in the combined planning group were also reminded to formulate another set of coping plans. Participants in both planning groups completed the plans on their own, ensuring that all three groups received equal contact time at this point. Seven days later, all participants completed Questionnaire 3 (self-report exercise behavior). Participants were then debriefed and given a final opportunity to re-consent. The conduct of the trial followed the ethical principles of research outlined in the Declaration of Helsinki (World Medical Association, 2008) and the World Health Organization's (WHO) Handbook for Good Clinical Research Practice (WHO, 2005).

### Data analysis

All analyses were conducted using SPSS 17 for Windows. All analyses were by intention-to-treat and included all participants. Missing values at Time 3 ($n = 4$) were replaced with baseline scores. One-way ANOVA and Chi square procedures were used to ensure that there were no systematic differences between groups on demographic characteristics or baseline exercise. Independent $t$ tests and Chi square procedures were used to ensure that demographic characteristics and baseline and outcome variables (i.e., exercise scores at Time 3) were equivalent between local and remote participants. One-way ANOVA followed by post hoc tests (Tukey's procedure) was used to ensure that all groups assimilated the motivational intervention (i.e., PMT, goal intention) equally and that the action and combined planning groups assimilated their respective volitional intervention components. Finally, separate 3 (group) by 3 (time) repeated measures ANOVAs were conducted for each of the three exercise measures: self-report, objectively measured 30-min bouts of MVPA, and overall raw accelerometer counts. Significant interactions were followed by one-way ANOVAs with Tukey's procedure at Time 3.

## Results

### Group equivalency

No significant differences emerged (all $ps > .05$), indicating that there were no systematic differences between groups with respect to demographic variables or baseline exercise (Table 1). Due to these results, it was deemed unnecessary to use demographic variables as covariates in the subsequent analyses.

### Fidelity check

#### *Intervention delivery*

No significant group differences (all $ps > .05$) emerged between local and remote participants for any of the variables of interest (i.e., PMT variables, goal intention, action and coping planning, self-reported exercise, objectively measured 30-min bouts of MVPA, and total activity counts), confirming that no systematic differences existed based on intervention delivery style.[3]

#### *PMT and goal intention*

The three treatment groups did not differ significantly on PS, PV, RE, SE or goal intention, indicating that the PMT-based motivational intervention component was assimilated equally regardless of group assignment (Table 5).

#### *Action and coping planning*

As expected, significant group differences emerged for action planning and coping planning. Post-hoc analyses revealed that both the action planning and combined planning groups reported significantly higher action planning compared to the PMT-only group, and that participants in the combined planning group reported

[3] These data are available upon request from the principal investigator.

**Table 3** Accelerometry data collection and analytical procedures

| | |
|---|---|
| General information | |
| Device and manufacturer | Actical® (Mini Mitter Respironics, Inc., Bend, OR, USA) |
| Accelerometer type | Multidirectional, piezoelectric, with digital integration |
| Communication interface | USB to serial port adaptor |
| Predeployment calibration | Yes |
| Validated for use in adults | Yes (Heil, 2006) |
| Setup information | |
| Epoch | 1 min |
| Location worn | Left hip at mid clavicular line (via adjustable nylon belt) |
| Requested days of wear | Three 7-day periods (21 days total) |
| Wear instructions | During all waking hours (except for bathing) |
| Analytical decisions | |
| Nonwear time | 60 consecutive zeros (Colley et al., 2011) |
| Valid day criteria | 10 h of wear (Colley et al., 2011) |
| Valid file | At least 4 of 7 days (Colley et al., 2011) |
| Cut-point references | In the absence of pregnancy-specific Actical cut-points, manufacturer (Heil, 2006) cut-points corresponding to the following MET-values were used[a]: |
| | Light intensity (<3.0 METs) |
| | Moderate intensity (3.0 to <6.0 METs) |
| | Vigorous intensity (≥6.0 METs) |

[a] These MET-values are in line with exercise intensity recommendations for pregnant women (Chasan-Taber et al., 2007)

significantly higher coping planning compared those in the PMT-only group (Table 5).

## Intervention effects

### *Exercise behavior*

Exercise scores by group and time are illustrated in Fig. 2. Significant interactions were obtained for objectively measured 30-min bouts of MVPA, $F(2, 112) = 4.34$, $p = .003$, $\eta^2 = .13$, and self-reported exercise, $F(2, 112) = 4.55$, $p = .001$, $\eta^2 = .15$. All participants demonstrated higher levels of exercise at Time 2 compared to Time 1. Although all groups decreased their exercise level from Time 2 to Time 3, post hoc analyses (one-way ANOVAs with Tukey's procedure for Time 3 scores) revealed that for both exercise measures, participants in the two planning groups remained significantly more active at Time 3 compared to those in the PMT-only group. For MVPA bouts only, the difference between participants in the action planning and those in the combined planning group approached significance ($p = .08$), with participants in the combined planning group engaging in higher levels of exercise compared to those in the action planning group. No significant interaction effect emerged for total counts, $F(2, 112) = 1.47$, $p = .22$, $\eta^2 = .05$.

**Table 4** Accelerometer wear statistics by group

| Variable | PMT | AP | AP&CP |
|---|---|---|---|
| Time 1 (Baseline) | | | |
| Sample outfitted with accelerometer (n) | 20 | 21 | 19 |
| Failed to initialize/collect | 0 | 0 | 0 |
| Spurious occurrences (raw counts) | 0 | 0 | 0 |
| Not enough wear time | 0 | 0 | 0 |
| Viable sample with 4 or more valid days | 20 | | |
| (100 %) | 21 | | |
| (100 %) | 19 | | |
| (100 %) | | | |
| Average daily wear minutes (SD) | 821 (65) | 807 (68) | 828 (74) |
| Time 2 (1 week post-intervention) | | | |
| Sample outfitted with accelerometer (n) | 20 | 21 | 19 |
| Failed to initialize/collect | 0 | 0 | 0 |
| Spurious occurrences (raw counts) | 0 | 0 | 1 |
| Viable sample with 4 or more valid days | 20 | | |
| (100 %) | 21 | | |
| (100 %) | 19 | | |
| (100 %) | | | |
| Average daily wear minutes (SD) | 826 (67) | 818 (78) | 837 (68) |
| Time 3 (4 weeks post-intervention) | | | |
| Sample outfitted with accelerometer (n) | 18 | 19 | 19 |
| Failed to initialize/collect | 0 | 0 | 0 |
| Spurious occurrences (raw counts) | 0 | 1 | 0 |
| Viable sample with 4 or more valid days | 18 | | |
| (100 %) | 19 | | |
| (100 %) | 19 | | |
| (100 %) | | | |
| Average daily wear minutes (SD) | 801 (48) | 818 (87) | 832 (58) |

*AP* action-planning group, *AP&CP* action-and-coping-planning group, *PMT* PMT-only group, *SD* standard deviation

## Discussion

The results of the present study support our hypothesis and the view that augmenting a motivational intervention based on protection motivation theory with volitional HAPA based action planning or action and coping planning

**Table 5** PMT beliefs, goal intention, action planning, and coping planning scores and statistics between treatment groups

| Variables | PMT ($n = 20$) | AP ($n = 21$) | AP&CP ($n = 19$) | $F$ (2, 102) | $p$ | Effect size ($\eta^2$) | Post hoc |
|---|---|---|---|---|---|---|---|
| Perceived vulnerability | 2.78 (1.26) | 2.75 (.97) | 3.16 (1.01) | .86 | .43 | .03 | |
| Perceived severity | 4.90 (1.35) | 5.51 (1.05) | 4.68 (1.41) | 2.30 | .11 | .08 | |
| Response efficacy | 6.48 (.48) | 6.29 (.59) | 6.42 (.46) | .64 | .53 | .02 | |
| Self efficacy | 5.18 (1.16) | 5.13 (.98) | 5.27 (.90) | .11 | .90 | .00 | |
| Goal intentions | 5.75 (1.30) | 6.10 (.86) | 5.88 (.78) | .62 | .54 | .02 | |
| Action planning | 2.76 (.97) | 3.69 (.47) | 3.78 (.32) | 15.12 | .000 | .35 | AP > CO |
| | | | | | | | AP&CP > CO |
| | | | | | | | AP = AP&CP |
| Coping planning | 2.34 (.86) | 2.86 (.71) | 3.25 (.57) | 7.85 | .001 | .22 | AP&CP > CO |
| | | | | | | | AP&CP = AP |
| | | | | | | | AP = CO |

*AP* action-planning group, *AP&CP* action-and-coping-planning group, *PMT* PMT-only group. Each construct is reported as an average score calculated by summing the items and then dividing by the total number of items

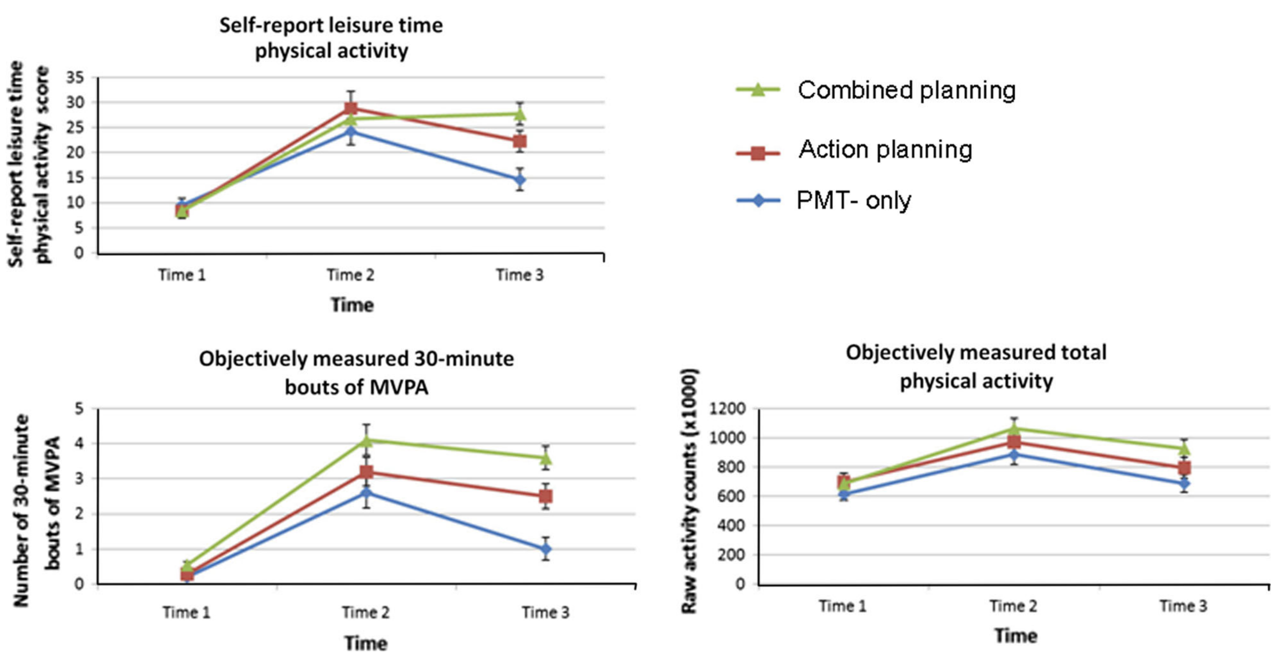


**Fig. 2** Mean and standard error scores between treatment groups across time for self-report and objective measures of physical activity. *MVPA* moderate-vigorous physical activity, *PMT* protection motivation theory. [Actual descriptive for these measures can be obtained by contacting the principal investigator (corresponding author)]

intervention components can enhance exercise behavior change among pregnant women. Beyond this generalized conclusion, several theoretical and methodological issues warrant discussion.

The results of this study support the benefits of a theoretically-integrated approach and the need for interventions to address both the pre-intentional motivational and the post-intentional volitional phases of behavior change. The failure of the PMT-only group to maintain increased exercise levels by Time 3 indicates that an intervention aimed at targeting PMT constructs alone was not sufficient to bring about behavior change extending to 4 weeks post-intervention. However, the success that this group demonstrated at Time 2 supports the utility of the model in influencing initial exercise behavior. It is also important to note that goal intention was not affected by the action or coping planning components. This observation is in line with meta-analytic findings (Webb & Sheeran, 2008). Since strong goal intentions are viewed as essential precursors of effective action and coping plans and successful behavior change even in the HAPA model, the importance of including the information aimed at influencing the four PMT factors should not be underestimated.

An examination of Fig. 2 demonstrates that although activity scores did somewhat decrease from Time 2 to Time 3 even for participants in the two planning groups, this decrease was clearly attenuated by the addition of the planning component of the intervention. In addition, it should not be overlooked that exercise becomes increasingly more difficult as pregnancy progresses. For this reason, a slight drop in both intensity and duration over the course of 4 weeks is likely to be expected even among the most motivated of exercisers.

It is possible that in addition to linking behavior to situational cues (Gollwitzer, 1999), part of the success of the volitional intervention component can be attributed to the fact that by formulating their own exercise plans, participants in the planning groups acted as active agents of change. Rather than treating participants merely as recipients of information, some have suggested that successful behavior change requires that participants collaborate both on the establishment of target outcomes as well as the processes employed to reach these outcomes (Rejeski et al., 2000).

The present results beg the question: Is action and coping planning superior to action planning alone? Unlike previous research (Sniehotta et al., 2006), there were no significant differences between the two planning groups even though a weak effect approaching significance did emerge in favor of the combined planning group for MVPA bouts only. In contrast to action planning, which can be easily defined and quickly learned, effective coping planning relies on the correct anticipation of personal risk situations (e.g., barriers, temptations, distractions) and requires at least some prior experience (Sniehotta et al., 2005). For this reason, coping planning is presumed to be less useful for predicting actual behavior in the beginning of a behavior change process compared to during the course of action (Sniehotta et al., 2005). This may be particular relevant to pregnancy and at least partly explain the present findings. For example, pregnant women face ongoing physiological and emotional changes which can make the advance anticipation of barriers tricky even for more experienced exercisers.

With respect to overall activity (measured through raw activity counts), scores were in the expected direction and followed the overall visual pattern demonstrated by the other two measures in Fig. 2 even in the absence of statistically significant group differences. This finding is encouraging, particularly in light of recent concerns that individuals may have an activity set-point which causes them to compensate for leisure time exercise by reducing their spontaneous free-living activity (Wilkin, 2011). The fact that no significant time by group interaction emerged for this measure is not surprising. The participants in the present study wore the accelerometer for more than 13 h per day and an additional three to four 30 min bouts of MVPA represent only a small percentage of total weekly activity.

To the best of our knowledge this study represents the first objectively-measured exercise intervention for pregnant women. Despite the widespread use of self-report measures, some have suggested that exercise interventionists make more of an effort to use objective measures (e.g., accelerometers) (Wareham & Rennie, 1998). While these are valid recommendations, the similarity between our participants' self-report and objectively-measured leisure time exercise supports the validity and usefulness of the Leisure Time Exercise Questionnaire (Godin & Shephard, 1985) in this population. Although self-report measures may be adequate for measuring leisure time exercise, accelerometry should remain the tool of choice for researchers whenever feasibility permits and particularly when free-living physical activity or total energy expenditure is of interest.

There are numerous strengths to this work, such as an experimental design, a theoretically integrated intervention approach which permitted the examination of unique intervention components, and excellent participant compliance to objectively measured exercise behavior over a substantial follow-up period. Despite these strengths and promising findings, several limitations should be acknowledged. One limitation is self-selection bias due to our recruitment method. In addition, these results can only be generalized to women who are white, married, and well educated. Future studies should also consider the inclusion of a true control group in order to examine whether action and coping planning mediate the intention-behavior gap. Finally, the investigator delivering the intervention was not blinded to group assignment. Although attempts were made to standardize intervention delivery (i.e., through the use of a predetermined script and email contact), the possibility of bias cannot be ruled out.

Several practical and research implications stem from these findings. From a practical standpoint, more cost-efficient intervention delivery methods need to be explored if such a program is to have large-scale applicability. For example, information aimed at changing perceptions of vulnerability and severity and improving response efficacy and self-efficacy for exercise could be incorporated into standard prenatal classes or delivered via a print-based intervention (e.g., Gaston & Prapavessis, 2009) and action planning (or combine planning) sheets could be provided in the form a workbook. Finally, as the use of mobile devices becomes increasingly widespread, researchers should explore the role that this technology can play in the delivery of effective exercise interventions. A recent review, for example, found considerable support for mobile health (mHealth) interventions for a variety of health behaviors (Fjeldsoe et al., 2009). Two key features that emerged were participant interactivity and content tailoring—medium characteristics which could easily facilitate an action and coping planning intervention.

From a research perspective, future studies should delve deeper into the processes of change associated with action and coping planning as they pertain to pregnancy. According to Zanna and Fazio (1982), for example, new concepts tend to progress through three distinct phases. First, is there an effect? Second, when and under what conditions does the effect occur? Finally, how does the effect occur? While the present research addressed the first question and provided compelling evidence for the added benefit of action planning, future research could explore the optimal conditions under which this effect occurs (e.g., does action plan quality influence success?) as well as the mechanisms of change associated with these benefits (e.g., how important are situational cues for action planning to be successful?). In addition, more research is needed before conclusions can be drawn regarding the usefulness of coping planning during pregnancy.

In addition, researchers should further explore the use of accelerometry during pregnancy and conduct validation studies to develop appropriate intensity cut-points for this population. Although Actical cut-points have been established for the general population (Colley et al., 2011), pregnancy is a unique period during which women are advised to monitor their heart rate and maintain levels of intensity which do not cause them to become out of breath (Davies et al., 2003). For these reasons, it is unlikely that general adult guidelines are appropriate for a pregnant population. Previous research has established alternate cut-points for other special populations, including obese individuals (Hooker et al., 2011) and children (Puyau et al., 2002).

In conclusion, this is the first study to demonstrate that augmenting an intervention designed to target PMT beliefs with a HAPA based action planning or action and coping planning intervention can enhance exercise behavior change among pregnant women.

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