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Examining predictors of physical activity among inactive middle-aged women: An application of the health action process approach

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Abstract

This study tested several relationships predicted by the Health Action Process Approach (HAPA) in a sample of 175 generally healthy, inactive, middle-aged women (40–65 yrs old) over a 12 week period. Participants' physical activity, risk perceptions, outcome expectancies, action self-efficacy, and intentions were measured at baseline. Planning and maintenance self-efficacy were measured four weeks later. Physical activity behaviour was measured twelve weeks after baseline. The HAPA relationships were examined using a structural equation model. The data fit the model well and revealed several significant relationships. Action self-efficacy was the best predictor of intention. Maintenance self-efficacy was the best predictor of planning and behaviour. Contrary to the tenets of HAPA and to past research, planning did not predict behaviour. Overall, HAPA provides a useful framework for identifying determinants of physical activity intentions and behaviour within a group of inactive, middle-aged women.

Despite the benefits of being active, less than half of American adults meet the recommended level of physical activity (National Center for Chronic Disease Prevention and Health Promotion website, 2009). Trends in physical activity participation rates are especially concerning in specific segments of the population. For example, levels of physical activity tend to decrease with increasing age (Hawkins et al., 2009; Jones, Ainsworth, Croft, Macera, Lloyd, & Yusuf, 1998) and women tend to be less active than men (Jones et al.; Marshall, Jones, Ainsworth, Reis, Levy, & Macera, 2007). These patterns suggest that middle-aged women are a particularly important group to target in physical activity promotion efforts. Promoting physical activity among middle-aged women may help to establish an active lifestyle that continues into older adulthood. Additionally, women's risk of developing health problems (e.g., heart disease, cancer) increases with age. Women can minimize their risk by increasing participation in physical activity (Baer et al., 2011; Eliassen, Hankinson, Rosner, Holmes, & Willett, 2010).

Research strongly advocates that practitioners who plan physical activity interventions for segments of the population, including middle-aged women, use behaviour change theories as the basis for their designs (Baranowski, Anderson, & Carmack, 1998; Speck & Harrell,

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2003). Using theory in designing interventions and research is important because it allows for testing of the theory's proposed causal relationships and, when successful, provides a map for future, effective interventions (Conner & Norman, 2005). Past research (e.g., Conn, Burks, Minor, & Mehr, 2003; Tavares & Plotnikoff, 2008; Vallance, Murray, Johnson, & Elavsky, 2010) has examined the utility of prominent theoretical frameworks including the theory of planned behaviour (TPB; Ajzen, 1988), social cognitive theory (SCT; Bandura, 1977), and the transtheoretical model of change (Palmeira et al., 2007; Prochaska & DiClemente, 1983) in predicting women's physical activity behavior. These studies provide some direction for developing physical activity interventions for women. The current study advances this research in two ways: a) we focus specifically on the determinants of physical activity among inactive, middle-aged women activity – a key group to target for intervention, and b) we test relationships between the constructs specified in the health action process approach (HAPA; Schwarzer, 2008). Some of these relationships are unique to the HAPA and thus testing this theoretical framework has potential to provide new insight into intervention strategies for middle-aged women.

The Health Action Process Approach

The HAPA attempts to improve on earlier models (Schwarzer, 2008). For example, both the TPB and SCT assume that behaviour is mainly the result of intentions (Schwarzer & Luszczynska, 2008). Therefore, these theories focus on identifying and suitably modifying the predictors of intentions. However, forming strong intentions to act does not necessarily lead to behaviour change (Armitage, 2005). This is often referred to as the "intention-behaviour gap." A meta-analysis of the intention-behaviour relationship found that a medium-to-large sized change in intention only leads to a small-to-medium sized change in behaviour (Webb & Sheeran, 2006). Therefore even if people form the intention to be more active, there is some chance that they will not successfully translate this intention to behaviour. With no post-intentional phase detailing how intentions are translated into actions, these models fail to explain behaviour fully (Schwarzer & Luszczynska, 2008).

The HAPA was developed to address the intention-behaviour gap by including post-intentional mediators of behaviour (Schwarzer & Luszczynska, 2008). This model is divided into two stages: the motivational stage which leads to behavioural intentions, and the volitional stage which leads to actual health behaviour (Heckhausen & Gollwitzer, 1987). In the motivational stage, risk perceptions, outcome expectancies, and perceived action self-efficacy contribute to forming intentions (Schwarzer, 2008). This stage therefore contains aspects of both SCT and TPB. The action or volitional stage is broken down into three phases, a planning phase, an initiation phase and a maintenance phase (Schwarzer, 2008).

It is this second stage that sets the HAPA apart from other theories, because it is one of the few models to incorporate volitional influences on behaviour (Conner, 2008). The inclusion of the planning construct has received significant empirical support. Planning refers to both action planning (the formation of detailed plans which specify when, where and how the behaviour will be performed), and coping planning (imagining barriers that may get in the way of a goal, and planning ways to overcome them; Schwarzer, 2008). A meta-analysis of 94 studies examining the effect of forming if-then plans (i.e., action plans also known as implementation intentions) on goal attainment showed a positive effect with a medium-to-large (Cohen, 1992) average effect size of .65 (Gollwitzer & Sheeran, 2006).

Another novel aspect of this model is the distinction between multiple types of self-efficacy (Conner, 2008). In the HAPA, a different type of self-efficacy is conceptualized for initiation which is part of the motivational phase, and maintenance and recovery, which are part of the volitional phase (Leventhal, 2008). Action self-efficacy refers to individuals'

belief, prior to initiating action, that they are capable of performing the behaviour. Maintenance self-efficacy is individuals' confidence that they will be able to deal with barriers that they may face while engaging in the behaviour. Finally, recovery self-efficacy comes into play when individuals experience a lapse in behaviour and refers to their belief in their ability to get back on track after being derailed (Schwarzer, 2008).

The HAPA has been used in research on a wide variety of health behaviours. One study compared three behaviour change theories' (the health belief model, the TPB and the motivational phase of the HAPA) ability to predict intentions to resist dieting and perform breast self-examination (BSE; Garcia & Mann, 2003). The motivational phase of the HAPA was the best predictor of intentions for both resisting dieting and performing BSE. Another study of BSE behaviour found further support for the HAPA, particularly the importance of planning as a mediator between intention and behaviour (Luszczynska & Schwarzer, 2003). The HAPA model has also been found to fit data from a South Korean sample, as in a recent study of healthy eating that showed maintenance self-efficacy to be the best direct predictor of a low-fat/high-vitamin diet in this population (Renner et al., 2008). Other studies have found the HAPA to be a useful model at predicting seat- belt use among Polish high school students (Schwarzer, Schuz, Ziegelmann, Lippke, Luszczynska, & Scholz, 2007), and good nutrition (Schwarzer & Renner, 2000).

There have also been several studies that demonstrate the HAPA to be successful in predicting physical activity with orthopaedic (Lippke, Ziegelmann, & Schwarzer, 2004; Ziegelmann, Lippke, & Schwarzer, 2006) and cardiac rehabilitation patients (Scholz, Sniehotta, & Schwarzer, 2005; Sniehotta, Scholz, & Schwarzer, 2005). At least one study has found the HAPA model to be a good predictor of physical activity in a non-rehabilitation population of South Korean adults (Renner, Spivak, Kwon, & Schwarzer, 2007), but we are unaware of any research to date examining the utility of the HAPA for predicting the physical activity behaviour of an exclusively inactive, middle-aged, healthy female population. Identifying a meaningful set of behavioural determinants in this population is critical for developing much needed theory-based interventions. Given that the HAPA has been shown to be a successful model in several different contexts, including in the study of middle-aged populations (e.g., in both the Scholz et al. and Sniehotta et al. studies, the mean age of participants was 59 years), women's health behaviours (Garcia & Mann, 2003), and physical activity, it appears to be a promising model to test in a population of inactive middle-aged women.

The Current Study

The current study tested several of the relationships associated with physical activity predicted by the HAPA in inactive, middle-aged, female population using a longitudinal design in a structural equation model. Given the past research with the HAPA, we hypothesized that the data would fit the model well. More specifically, we hypothesized that the model would support the following *direct* relationships, (a) risk perceptions, outcome expectancies and action self-efficacy would predict intention, (b) intention and maintenance self-efficacy would predict planning, (c) planning and maintenance self-efficacy would predict behaviour. If the direct relationships were supported, we also hypothesized that the model would support the following *indirect* relationships, (a) action self-efficacy, outcome expectancies and risk perception would affect planning through intention, (b) intention would affect behaviour through planning, (c) maintenance self-efficacy would affect behaviour through planning.

Method

This study involved secondary analysis of data from a larger study examining message tailoring and physical activity. This study received ethics approval from the Research Ethics Board at Yale University. Participants in this larger study were recruited from the National Cancer Institute's Cancer Information Service (CIS). These were individuals who called into the telephone-based CIS for information. In order to participate, they must *not* have met the Centers' for Disease Control and Prevention (CDC) physical activity recommendation (i.e., at least 30 minutes of moderate-intensity physical activity on 5 or more days/week or 20 minutes of vigorous-intensity physical activity on 3 or more days per week). In addition, participants must not have had cancer or be awaiting test results about possible cancer diagnosis. All participants were mailed one of six versions of a brochure with information about physical activity and cancer. Each brochure provided information about how physical activity can reduce the risk of cancer and how much activity is recommended for health benefits.

The data used in this study were those collected after the intervention had been administered. The effects of this minimal contact intervention were negligible. While participants received different physical activity messages, no intervention effects were apparent in the data used for the current study.

Participants

The data used in the current study are from a sample of 175 middle-aged women (i.e., aged 40–65; M_{age} = 51.97, SD = 7.64 years). All participants were generally healthy and inactive ($M_{activity}$ = 11.63, SD = 20.20 minutes of moderate to heavy activity/day). Inactive is defined as engaging in less than 75 minutes of moderate to heavy physical activity per week at Time 1. In applying this criterion none of the women were meeting the CDC physical activity recommendation of 150 minutes of moderate intensity physical activity per week, or 75 minutes of heavy intensity physical activity or some combination of both moderate and heavy intensity physical activity. Reported levels of moderate physical activity increased from Time 1 to Time 3, $t(173) = -4.08$, $p < .01$. Levels of vigorous physical activity were unchanged ($p > .05$). With a mean body mass index was 27.81 (SD = 6.15), most women in the sample were overweight or obese (64.9%). The majority of participants were white (73.1%). The sample was relatively educated with 68.6% reporting received at least some college education. Participants' level of income ranged from less than $20,000 (18.3%) to $80,000 or above (20.6%) with a median of $40,000–$59,000.

Participant retention rates were high throughout the study. Only 14 participants could not be reached for the Time 2 interview (92% retention rate; n=160) and only 1 participant could not be reached for the Time 3 interview (99.8% retention rate; n=174). ANOVA comparing age and baseline HAPA values between participants who completed and did not complete the Time 2 interview were not significant. The sample size was too small to compare the demographic characteristics of participants who completed and those who did not complete Time 2.

Procedure

Prior to beginning the study, verbal informed consent was obtained from all participants. Participants were contacted by phone at three time points (Time 1–3) after the intervention for the larger study was complete. These phone calls took place at baseline (Time 1; following the completion of the intervention), and four (Time 2) and twelve (Time 3) weeks later. Risk, outcome expectancy, action self-efficacy, and intention items were assessed at

Time 1; planning and maintenance self-efficacy were assessed at Time 2; and physical activity behaviour was assessed at Time 3.

Measures

Risk perception—Risk perception was assessed at Time 1 with four items measuring individuals' perceived likelihood of developing cancer during their lifetime. The items relate to cancer because the brochures in the larger study discussed the relationship between physical activity and cancer. Responses ranged from 1 (*strongly disagree, much lower, not likely*) to 5 (strongly agree, much higher, extremely likely). These items were adapted from Graham, Prapavessis, and Cameron (2006).

Outcome expectancy—Outcome expectancy was assessed at Time 1 with three items asking participants about the effect of physical activity on cancer risk. Responses ranged from 1 (*strongly disagree, not at all effective*) to 5 (*strongly agree, extremely effective*). These items were adapted from Courneya and Hellsten (2001).

Action self-efficacy—Action self-efficacy was assessed at Time 1 with five items regarding individuals' confidence, capability, and ability to participate in the recommended amount of physical activity over the next two weeks. Prior to answering the questions, participants were provided with the recommendation as well as the definition of moderate and vigorous physical activity. Responses were on a scale from 1 (*not confident, not likely, strongly disagree*) to 5 (*completely confident, extremely confident, strongly agree*). These items were adapted from Armitage and Conner (1999).

Intention—Intention was assessed at Time 1 with two items asking participants how much they intended and planned to try to participate in the recommended amount of physical activity during their leisure time over the next two weeks. Responses ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). These items are commonly used by Ajzen (e.g., Ajzen, Brown, & Carvajal, 2004) to assess intentions.

Planning—Planning was assessed at Time 2 with one item asking if participants had made a detailed plan about when, where, and how they would engage in physical activity over the next two weeks. Responses ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). This measure was adapted from Sniehotta, Scholz, and Schwarzer (2005).

Maintenance self-efficacy—Maintenance self-efficacy was measured at Time 2 with eight items regarding barriers to participating in physical activity. They were asked in the form, "How confident are you that you will do the recommended amount of physical activity during your leisure time in the next 2 weeks even if…," followed by the following barriers: limited time, bad weather, feeling tired, feeling stressed, competing interests, no one to be active with, lack of enjoyment, and not receiving support from family or friends. Responses ranged from 1 (*not confident*) to 5 (*completely confident*). These items are in accordance with the conceptualization of maintenance self-efficacy by Sniehotta et al. (2005).

Behaviour—Behaviour was assessed with the International Physical Activity Questionnaire (IPAQ) telephone-administered short form at Time 1 for descriptive purposes and at Time 3 for inclusion in the predictive model. This measure consists of seven items assessing participants' walking, moderate- and vigorous-intensity physical activity during the last seven days. Only the four items assessing moderate and vigorous physical activity were considered in this analysis. Specifically, participants were asked to provide the number of days in the last seven in which they engaged in moderate and vigorous activity, as well as the average amount of time (in minutes) spent doing each activity. The number of days was

multiplied by the number of minutes for each category and then by the corresponding MET value (4.0 for moderate-intensity and 8.0 for vigorous-intensity). These two composite scores were then summed to obtain a total moderate to vigorous physical activity score. The focus on moderate- and vigorous-intensity activity is consistent with the CDC's physical activity recommendations (National Center for Chronic Disease Prevention and Health Promotion website, 2009). The short form IPAQ has criterion validity that is at least as good as other self-report measures of physical activity. Agreement between the short form IPAQ and actual physical activity as measured with an accelerometer has been found to be fair with a Spearman's correlation of .30 (Craig et al., 2003). While there are objective measures of measure physical activity, self-report data was chosen as it is the most practical method by which to collect a large sample of data in a large geographical area (Dishman, Washburn, & Schoeller, 2001; Kriska & Casperson, 1997). Furthermore, even when participants recruited from the CIS are asked to use an objective method of measuring physical activity, such as wearing pedometers, the reliability with which they are used may not provide sufficient information (e.g., being worn less than 11 days per month; Latimer et al., 2008).

Data Analysis

Structural equation modeling (SEM) was used to analyse the data. The models were computed in AMOS 19.0 (Arbuckle, 2006). The covariance matrix was analysed using the maximum likelihood estimation procedure; treatment of missing values was done by the full information maximum likelihood method. As a first step, confirmatory factor analysis was used to test the measurement model. For this step, the first indicator of each latent variable was fixed to 1.0. Subsequently, the hypothesized structural relationships were tested with the theoretically-based structural equation model which consisted of seven latent variables. The model was specified as follows: at Time 1 with action self-efficacy, outcome expectancies and risk perception as exogenous variables and intention as an endogenous variable; at Time 2 with maintenance self-efficacy and planning as endogenous variables; and at Time 3 with physical activity behaviour as an endogenous variable. To account for the influence of age on HAPA relationships (Renner, Spivak, Kwon, & Schwarzer, 2007; Scholz, Schuz, Ziegelmann, Lippke, & Schwarzer, 2008), age was included as an exogenous variable predicting intention, planning and Time 3 physical activity behaviour. More detailed information regarding the measurement and final models is provided in the results section. Refer to Figure 1 for the full path diagram.

To assess the fit of the model, both absolute and incremental fit indexes were examined. The absolute fit indexes directly assess how well the a priori model reproduces the data, whereas the incremental fit indexes assess how superior the proposed model is compared with a more restricted baseline model (Hu & Bentler, 1999). The absolute fit indexes that are reported include the chi-square (χ^2) and the root mean square error approximation (RMSEA), including 90% confidence intervals. The χ^2 test has been criticized, because of its very high likelihood of significance in a large sample (Hu & Bentler, 1995). For the RMSEA, values below 0.08 are suggested and indicate a reasonable fit of the data to the model (Browne & Cudeck, 1993). The two incremental fit indexes that are reported in the current study include the comparative fit index (CFI), the Tucker-Lewis index (TLI). The cut-off criteria for these incremental fit indexes to determine an acceptable model fit are values close to .95 (Hu & Bentler, 1999). To test the significance of the hypothesized indirect effects, the 95% confidence intervals (CI) were computed using Sobel tests (Sobel, 1986). These were conducted on bootstrapped (20,000 samples) values of unstandardized, indirect path coefficients (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). A confidence interval that did not include zero indicated a significant effect.

We examined the univariate normality of the data. The physical activity data were positively skewed. To remedy non-normal data distributions, a square root transformation was applied

to the measure of Time 3 moderate activity and an inverse transformation was applied to the measure of Time 3 vigorous activity.

The multivariate normality of the model was assessed. In order to run this analysis in AMOS, complete data is required. For this reason, we imputed missing data points using the Expectation-Maximum algorithm (which provides maximum likelihood estimators) in SPSS. Mardia's normalized estimate of multivariate kurtosis was 20.02 indicating that the data were somewhat non-normally distributed. Because the maximum likelihood estimation procedure is robust to modest violations of multivariate normality (Fan & Wang, 1998), and because the data were univariate normal (after transformation to the physical activity data), we proceeded with analysing the SEM.

Results

Descriptive Statistics

To examine the descriptive statistics, average subscale scores were calculated for each of the HAPA constructs (all scales ranged from 1–5). Participants' average scores were fairly neutral for risk perceptions ($M = 3.17$, $SD = 1.18$, $\alpha = .92$), planning ($M = 3.01$, $SD = 1.48$), and maintenance self-efficacy ($M = 2.95$, $SD = 1.15$, $\alpha = .95$). In other words, participants felt they were somewhat at risk for developing cancer, they neither agreed nor disagreed to having made plans to be active, and they were moderately confident that they could overcome barriers to being active. Participants generally agreed that the effect of physical activity on cancer would be positive (outcome expectancies; $M = 3.89$, $SD = .99$, $\alpha = .82$), that they had intentions to be physically active (intention; $M = 3.66$, $SD = 1.31$, $\alpha = .93$), and that they felt somewhat confident in their ability to participate in physical activity (action self-efficacy; $M = 3.40$, $SD = 1.05$, $\alpha = .85$). Participants did not engage in physical activity very often ($M = 0.68$ days of activity per week, $SD = 1.24$) nor for a very long period of time when they were active ($M = 7.50$ minutes per day, $SD = 13.74$).

Correlations among variables are reported in Table 1. Action self-efficacy was positively associated with all other variables except for age and risk perceptions. Maintenance self-efficacy was positively associated with all other variables except for age and risk perceptions. Risk perceptions were not associated with any variables. Outcome expectancies were also related to intentions, planning and physical activity. Intentions and planning were also positively associated. Both types of self-efficacy were positively associated with physical activity and age was negatively associated with physical activity.

Structural Equation Model

Prior to testing the structural model, confirmatory factor analysis was run for all of the latent variables. The standardized factor loadings for the indicators of all latent variables were significant ($p < .05$). All factor loadings were greater than 0.60, except the transformed measures of moderate and vigorous physical activity at Time 3, which had loadings of .53 and −.64 respectively. The factor loadings for action self-efficacy ranged from .67–.84., for risk perceptions ranged from .82–.90, for outcome expectances from .70–.91, for intentions the factor loadings were .91 and .95, for maintenance self-efficacy factor loadings ranged from .79–.87. Although the χ^2 was significant ($\chi^2(268) = 471.34$, $p < .01$), other fit indexes demonstrated at least acceptable fit; CFI = .92, TLI = .91, RMSEA = .07, 90% CI = .06–.08.

The SEM with the various hypothesized paths was then analysed while the chi-square was significant, $\chi^2(286) = 497.59$, $p < .01$, the incremental fit indexes indicated acceptable fit: CFI = .92, TLI = .90, RMSEA = .07, 90% CI = .06–.08. The model accounted for 57% of the variance in intention, 56% of the variance in planning, and 15%[1] of the variance in physical activity behaviour.

As hypothesized, higher outcome expectancies at baseline were associated with greater intentions to engage in physical activity. Similarly, higher levels of action self-efficacy at baseline were also associated with greater intentions. In turn, intention and maintenance self-efficacy positively predicted planning. Maintenance self-efficacy also positively predicted physical activity behaviour at Time 3. The remaining direct relationships predicted by the HAPA were not significant (see Figure 1 for beta coefficients)[1].

The following indirect relationships were also hypothesized: (a) action self-efficacy, outcome expectancies and risk perception would affect planning through intention, (b) intention would affect behaviour through planning, and (c) maintenance self-efficacy would affect behaviour through planning. However, because the direct relationship between risk perception and intention was not significant, the indirect relationship from risk perception to intention to planning was not tested. Of these predictions, only the indirect effects of action self-efficacy to intention to planning (95% CI = .06–.41) and outcome expectancies to intention to planning (95% CI = .00–.14) were significant.

Exploratory Analyses

Two further exploratory analyses were run. First, planning was removed from the model to determine if intention predicted behaviour directly. This relationship was not significant (p = .14). Second, the direction of the arrow between maintenance self-efficacy and planning was reversed to examine the indirect relationship from planning to maintenance self-efficacy to behaviour. This relationship was found to be significant (CI = .18–.72).

Discussion

HAPA Relationships Demonstrated in Our Model

The aim of this study was to test several of the relationships predicted by the HAPA in the context of physical activity patterns of middle-aged inactive women. The majority of the hypothesized relationships were found to be significant. With many of the previous HAPA and physical activity studies conducted in clinical populations, the findings from the current study extend the evidence of the usefulness of HAPA in predicting physical activity behaviour.

The support for the hypothesized relationships is consistent with research testing a HAPA-based model (Lippke et al., 2004; Renner et al., 2007; Scholz et al., 2005; Sniehotta et al., 2005; Ziegelmann et al., 2006) and research examining determinants of physical activity behaviour among women of all ages (Conn et al., 2003; Tavares & Plotnikoff, 2008; Vallance et al., 2010). In particular, both action self-efficacy and outcome expectancies were found to be significant predictors of women's intentions, explaining 57% of the variance with action self-efficacy being the greater predictor. This finding implies that the women's belief in their capabilities, prior to initiating action, is one of the most important factors in determining whether or not they formed an intention. Additionally, outcome expectancies affected women's planning indirectly through intentions. This finding is consistent with the

[1]According to Weinstein (2007), failing to control for past behaviour can cause overestimation of the relationship between social cognitions and behaviour. In contrast controlling for past behaviour can lead to underestimation. To address these bias we also tested our model including behaviour at Time 1 as an exogenous variable predicting physical activity at Time 3. The model was significant, χ^2 (332) = 542.80, p < .01, and the incremental fit indexes indicated acceptable fit: CFI = .92, TLI = .91, RMSEA = .06, 90% CI = .05–.07. The model accounted for 58% of the variance in physical activity behaviour. Whereas maintenance self-efficacy emerged as a direct predictor of behaviour in the model without past behaviour, it was not a direct predictor model that included past behaviour. This suggests that the inclusion of past behaviour in this model may indeed underestimate the relationships between social cognitions and behaviour. The indirect relationship of planning and behaviour mediated by maintenance self-efficacy was significant in both models ($CI_{\text{past behaviour}}$ = .02–.59).

HAPA model and indicates that increasing inactive women's outcome expectancies may result in increased levels of planning.

Both intentions and maintenance self-efficacy were significant predictors of planning, explaining a combined 56% of the variance. Maintenance self-efficacy, the women's confidence that they would be able to deal with barriers that they may face while engaging in the behaviour, was the stronger predictor. Action self-efficacy also affected planning indirectly through intention. This indirect effect has been suggested in past research with the HAPA (e.g., Schwarzer et al., 2007; Sniehotta et al., 2005), but it has rarely been tested.

Maintenance self-efficacy predicted women's physical activity. The importance of maintenance self-efficacy is in line with prior research that has found it to be one of the best direct predictors of physical activity (Renner et al., 2007; Tavares & Plotnikoff, 2008). Confidence in one's ability to deal with barriers that may arise while engaging in physical activity may be particularly important in an inactive sample, such as the one used in this study. When women are engaging in little or no activity, the prospect of doing so, particularly considering all the things that could get in the way, may seem overwhelming (Rye, Rye, Tessaro, & Coffindaffer, 2009). However if they are confident in their ability to manage the difficulties that may arise as they begin to be active, women may be more likely to follow through with their intentions.

It is apparent from these results that self-efficacy is important in the prediction of intention, planning, and physical activity behaviour. These findings provide particular support for the emphasis that the HAPA places on phase-specific multiple types of self-efficacy. The fact that action self-efficacy was directly related to intentions and indirectly related to planning suggests that this construct plays a role in both preintentional motivation and postintentional volition phase processes. The current study did not include a measure of the third type of self-efficacy suggested by the HAPA, recovery self-efficacy. However, given that the sample was not very active, the number of participants for whom recovery self-efficacy would be relevant was minimal. If the strong relationships between the different types of self-efficacy and predictors of physical activity behaviour hold in future research, particularly the direct relationship between maintenance self-efficacy and behaviour, then this will have implications for physical activity promotion strategies for women.

The model in the current study accounted for 15% of the variance in physical activity. This value falls just below the range of variance explained (17–32%) in previous studies using HAPA-based models to predict physical activity behaviour (e.g., Lippke et al., 2004; Renner et al., 2007; Scholz et al., 2005; Schwarzer et al., 2007; Sniehotta et al., 2005). Studies using other social cognitive theories to predict women's physical activity explain between 9–60% of variance in behaviour (Arbour & Ginis, 2004; Conn et al., 2003; Tavares & Plotnikoff, 2008; Vallance et al., 2010). The amount of variance explained in the current study falls at the lower end of this range. Unlike many of these other studies, our study included inactive women only. Our findings may be an indication that the HAPA constructs, many of which overlap with other social cognitive theories, do not apply as well to inactive women as they do to more active women.

HAPA Relationships Not Demonstrated in Our Model

Contrary to the model, risk perception did not predict intention. However, this lack of relationship between risk perception and intention has also been found in other studies (Luszczynska & Schwarzer, 2003; Schwarzer & Renner, 2000; Tavares & Plotnikoff, 2008). Risk perception is said to be the most distal predictor of intentions (Schwarzer, 2008), and it may have an influence early on in considering the behaviour but may no longer be relevant once intentions are being formed (Luszczynska & Schwarzer, 2003). The lack of

relationship in the current study also may be the result of a measurement confound. We only assessed women's perception of their risk of cancer. This focus on cancer aligned with the objectives of the larger trial. However, some women in the study may not be motivated by an increased risk of cancer, but may be motivated by the perception of other risks such as heart disease or type II diabetes.

Contrary to past research, the hypothesis that intention would affect behaviour indirectly through planning was not supported (Norman & Conner, 2005; Orbell, Hodgkins, & Sheeran, 1997; Schwarzer, 2008). Furthermore, the hypothesis that maintenance self-efficacy would affect behaviour through planning was not supported. The lack of significant findings may be partly due to the fact that we measured non-prescribed, leisure time physical activity. Many of the prior studies with physical activity and the HAPA have used participant samples drawn from a clinical population attending scheduled rehabilitation sessions. Attending a session at a predetermined place and time captures the essence of planning. In a general population sample, leisure time activity is often unstructured and does not naturally facilitate planning (Schwarzer et al, 2007). Indeed, the planning scores reported in studies of clinical populations (Scholz et al., 2005, Sniehotta et al., 2005, Lippke et al., 2004) are higher than those in the current study (clinical: 2.90 – 3.57 out of 4, or 7.25 – 8.93 out of 10 vs. inactive women: 3.01 out of 5, or 6.02 out of 10). However it is also possible that the fact that the planning measure used in the current study combined three aspects of planning (when, where, how) affected the lower mean planning scores. If individuals planned when and where they would be active, but not how, for example, they may then report lower levels of planning using this measure.

Another possibility is that the lack of a coping planning measure affected the lack of relationship between planning and behaviour. Coping planning refers to imagining potential barriers that may occur and making a plan to overcome them. This type of planning may be particularly important for a complex behaviour like physical activity for which there are many possible barriers. This is in contrast to more simple behaviours like seat belt use or dental flossing, or one time behaviours like mammography screening. Further research is required to explore the role that planning plays in predicting physical activity behaviour in the general population.

Exploratory Analyses

The exploratory analyses that were performed do not represent relationships that are predicted by the HAPA model, however they do provide some interesting findings. First, it is notable that intention was not a significant predictor of physical activity behaviour. This further establishes the so called intention-behaviour gap that is often noted in the literature (e.g., Webb & Sheeran, 2006). In addition, among inactive women it may be preferable to use theories that do not rely on intention as a primary predictor of behaviour (e.g., the HAPA, SCT).

The second exploratory relationship tested was the indirect relationship of planning on behaviour via maintenance self-efficacy. This relationship is the reverse of that predicted by the HAPA (maintenance self-efficacy is hypothesized to predict planning, and planning to predict behaviour). However, this reverse pathway has been found in other research as well (e.g., Williams & French, 2011). For example, Arbour-Nicitopoulos and colleagues (Arbour-Nicitopoulos, Martin Ginis, & Latimer., 2009) found that scheduling self-efficacy (similar to maintenance self-efficacy) partially mediated the effects of a planning intervention on the physical activity behaviour of adults with spinal cord injury. Another study evaluating a planning intervention in middle-aged women found that planning was related to having higher scheduling self-efficacy (Arbour & Martin Ginis, 2004). In a meta-analysis examining interventions that effectively change self-efficacy and physical activity

behaviour, planning was identified as a critical intervention component (Williams and French, 2011). Gollwitzer (2003) offers an explanation for these findings. Individuals at the point of setting goals and of creating action plans may experience an optimistic bias affecting their perceptions of control. This bias may manifest increased maintenance self-efficacy. Additional research is needed to explore the implications of this bias and whether it emerges in other populations.

Strengths and Limitations

This study had many strengths. The population was unique. Very little research examines predictors of physical activity among inactive adults – a group sorely in need of theory-based interventions promoting physical activity. The longitudinal design of the study was well suited to test the predictive relationships specified in HAPA. The high participant retention rates were a strength of the study. There retentions rates likely were due to a rigorous callback schedule and a run in period from the larger study (i.e., the participants included in the analyses reported in this paper are the participants who could be reached for follow-up in the larger study).

Although this study had several strengths, there were also some limitations. While many of the HAPA constructs were considered, the following were not: coping planning, recovery self-efficacy, and behaviour maintenance. The action planning measure only consisted of one item and additional items may improve upon it. Additionally, this one item consisted of three parts (when, where and how they would engage in physical activity) which may have conflated the various aspects of planning. Having three separate items would be preferable. All measures were self-report. These measures are subject to social desirability bias affecting the accuracy of the data. The model did not include past behaviour and as such may overestimate the relationships between HAPA constructs and behaviour[1]. The sample used was predominantly female and Caucasian which may limit the generalizability of findings to the broader population. Given the number of parameters in the model, the size of the sample is not as large as would be ideal. Additionally, we were unable to assess age as a moderator in the model due to insufficient sample size. Future researchers should consider examining this relationship. Finally, it should be noted that while the model fit the data relatively well, there may be other models that also fit the data. An alternative model that includes direct paths from action self-efficacy to behaviour, intention to behaviour, and recovery self-efficacy to action/coping planning warrants future consideration.

Conclusion

This study demonstrated that the HAPA-based model fit the sample of inactive middle-aged women well. Both action and maintenance self-efficacy were particularly important predictors in the model. Thus, placing greater emphasis on increasing multiple types of self-efficacy may enhance the effectiveness of interventions promoting physical activity to inactive middle-aged women.

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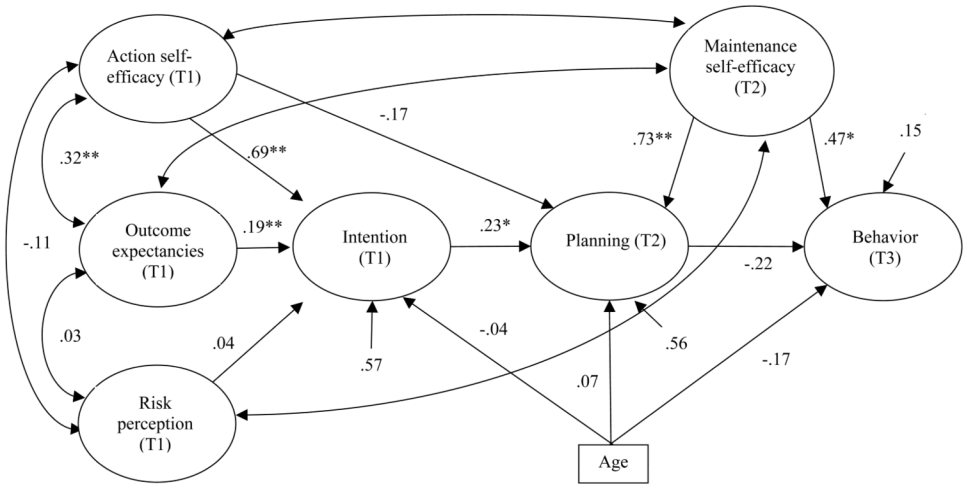

Figure 1.
Structural equation model, CFI = .92, TLI = .90, RMSEA = .07, * < .05, ** <.01

Table 1

Correlations Among Variables Included in Causal Model

Variable	1	2	3	4	5	6	7	8
1. Age	1							
2. Action self- efficacy (T1)	−.09	1						
3. Outcome expectancies (T1)	−.03	.32**	1					
4. Risk perceptions (T1)	−.12	−.11	.03	1				
5. Intentions (T1)	−.10	.62**	.39**	−.01	1			
6. Maintenance self-efficacy (T2)	−.11	.41**	.26**	−.01	.48**	1		
7. Planning (T2)	−.03	.30**	.32**	.07	.46**	.69**	1	
8. Physical activity (T3)	−.16*	. 19*	.02	−.15	.12	.21*	.04	1

Note.

** $p < .01$

* $p < .05$