

# **Theory of Planned Behavior: Item response sets and the prediction of physical activity**

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## ABSTRACT

**Background:** Less than half of Americans meet the recommendation of leisure-time physical activity (PA) of 150 minutes (CDC, 2012). A number of efficacious programs have been developed, and those that are based on theory are more effective. However, it is often difficult to determine the mechanisms of effect through mediational analyses. This is particularly an issue when a theory-based intervention is effective but theoretically hypothesized mediational relationships are not found. One reason for the lack of relationship could be the methods used to assess different theoretical constructs. The Theory of Planned Behavior (TPB) is one model used in the exercise and PA research domain which generally employs traditional fixed-graded measures of proposed theoretical mediators (e.g., strongly disagree to strongly agree response sets). More recent research provides initial evidence that using continuous-open scaling (e.g., ratio-level scaling; days or time/week rather than agreement scales) has shown the superiority in measurement accuracy demonstrated by stronger relationships between the theoretical constructs and behavioral outcomes when compared to other scaling types. However, continuous open scaling has only been applied to correlational studies and there is no evidence that this scaling procedure results in measures that are sensitive to change or are related to both self-reported and objectively measured PA.

**Primary Aims:** The primary aims of this study were to determine 1) the sensitivity to change of TPB constructs using different response sets and self-report and accelerometer assessed PA, and 2) if TPB constructs measured using the different response-sets have differential prediction of PA measured using self-report and accelerometry.

**Methods:** Forty-six young adults were recruited to complete 13-item measure of TPB constructs using both fixed-graded and continuous-open scales as well as Godin's Leisure Time Exercise Questionnaire at 3 time (T1=Baseline, T2=End of week 1, T3=End of week 2) points over 2-weeks. Potential participants were excluded if they engaged in PA of 150 minutes or more per week. Inclusion criteria were the ability to perform moderate intensity PA and aged 18-25 years old. The order of different scales for the TPB constructs was randomly and evenly assigned within each condition. Participants were asked to wear an accelerometer for 2 weeks; one week prior to the action planning activity and one week after. To determine the sensitivity to change of the measures, participants were randomly assigned to either complete a personal action plan for physical activity (AP) or not (Control). Due to the exploratory nature of the pilot we set the significance level for all tests at  $p < 0.10$ .

**Results:** In general responses to the continuous open versus fixed closed items, at each time point, resulted in significantly ( $p < .05$ ) lower perceptions of attitude (instrumental attitudes T1=4.4, T2=4.2, T3=4.3 versus time1= 6.2, T2=6.4, T3=6.3; affective attitudes T1=3.6, T2=3.5, T3=3.9 versus time1= 5.0, T2=5.0, T3=4.8), subjective norm ( T1=3.4, T2=3.3, T3=2.4 versus time1= 5.3, T2=5.2, T3=5.3), perceptions of control ( T1=3.2, T2=3.7, T3=3.9 versus time1= 4.6 T2=4.9, T3=5.2), and intention (T1=1.5, T2=1.8, T3=2.4 versus time1= 4.8, T2=5.1, T3=5.2). In regards to sensitivity to change continuous open and fixed closed measures of instrumental attitudes, subjective norms did not demonstrate significant changes as a result of action planning.

Affective attitudes measured by the continuous-open scale, but not when measured by the fixed-closed scale, showed change over time regardless of condition. Perceived behavioral control measured using the continuous-open scale increased for AP participants by approximately 0.5 compared to control participants change of approximately 0.1 ( $p=.09$ ). A similar pattern was found with intention in that changes in the continuous-open scale were significant (AP=0.9; control=0.2;  $p=0.07$ ). No other scales showed significant sensitivity to change. Self-reported PA increased significantly for AP participants ( $81\pm 18$  to  $97\pm 16$  minutes per week of PA) when compared to control participants ( $87\pm 19$  to  $75\pm 17$  minutes per week of PA;  $p<0.1$ ). Same pattern of differences was shown between AP ( $65\pm 13$  to  $107\pm 15$  minutes per week of PA) and control ( $70\pm 14$  to  $65\pm 16$  minutes per week of PA) participants ( $p<0.05$ ).

**Conclusions:** Continuous open scaling have significant correlations with all constructs along with affective attitude and intention being correlated with the actual reported exercise behavior over fixed graded scaling. This data sheds further insight into the different response sets of the TPB in application to exercise domain within a sedentary, young population. The lack of a significant difference may be due to the small sample size. Further research should investigate the role of the personalized action plan utilizing a larger sample size and the correlation of the TPB with intention and actual exercise behavior within an intervention

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## ***Chapter 1: Literature Review***

### *Introduction*

Physical inactivity has been linked to development of several chronic diseases along with increased risk for early mortality (Dunn et al., 2010; King, 2012; Garber & Nigg, 2012). Even with well documentation of the health risks of physical inactivity, the majority of people still do not meet the minimum recommended amount of 150 minutes of accumulated physical activity provided by the Centers for Disease Prevention and Control (CDC) (U.S. Department of Health and Human Services, 2008). Interventions that promote physical activity (PA) and results in an increase in PA are of great value. Assessment of physical activity usually relies on self-report which make the validity of the self-report scales of great interest (Rhodes, Matheson, & Blanchard, 2006). The development and implementation of efficacious programs through behavior change has shown to be enhanced and thus more effective when a theoretical model is used (Campbell et al., 2000; Craig et al., 2008).

There is a need to understand the determinants and correlates of physical activity in order to create a physical activity intervention that will lead to success. While numerous studies have documented the benefits of regular PA, the route cause to explain behavior change for successfully increasing PA is still under speculation. The Theory of Planned Behavior (TPB) has been used extensively to predict physical activity with self-report measures (Rhodes, Matheson, & Blanchard, 2006; Hagger, Chatzisarantis, & Biddle, 2002). The TPB is one of the commonly used theories in the exercise domain and generally uses fixed graded measurements (also referred to as dichotomous).

While a number of interventions have been developed based on a theoretical model like the TPB, few are able to demonstrate changes in the theoretical constructs that are able to mediate

the interventions' influence on desired behavior directly and when they do, the relationships are typically modest (Bartholomew, Parcel, & Kok, 1998). For example, a meta-analysis by Armitage & Conner (2001) reviewed 185 independent studies and found that 27-39% of the variance was accounted for in the behavior and intention, respectively. Of interest, when behavior measures were collected by objective or observed behavior, the TPB constructs accounted for 11% less of the variance in behavior than when the behavior measures were conducted in self-report. The goal of this literature review is to provide a brief overview of the use of TPB in exercise and physical activity research and more recent work that has examined methods to improve the validity and inter-construct relationships of TPB measures.

### *Theory of Planned Behavior*

One of the leading theories used to explain the relationship of motivational influences on behavior is the Theory of Planned Behavior (TPB) which states that attitude toward behavior, subjective norms, and perceived behavioral control together shapes a person's intentions and behaviors (Ajzen, 1985, 1991). It was first developed by Icek Ajzen in 1991 and subsequently has been supported by further research as one of the leading theoretical models in prediction of health behaviors such as physical activity (Godin & Kok, 1996). Meta-analyses of the effectiveness of TPB have provided strong support for the predictive validity of the theory in application of the percentage of variance provided from behavior and intention of behavior (Armitage & Conner, 2001), but TPB was only capable of providing for 20% of the variance measures of actual behavior, and rarely tested within an intervention context. More recent evidence from physical activity determinant studies pointed to less than half of intention and actual exercise (McEachan et al., 2011; Symons Downs & Hausenblas, 2005). The direct



determinant of a conscious choice in a behavior is seen as one's intention to engage in that behavior.

The TPB constructs are considered attitudes, subjective norms, and perceived behavioral control which directly affects behavioral intentions (Rhodes, Matheson, & Blanchard, 2006). Behavioral intention is considered to be the best predictor of the actual behavior being performed (Montano & Kasprzyk, 2008).

Attitudes are considered the individual's belief of performing a specific behavior in a negative or positive way. Attitudes is further broken down into affective (e.g., enjoyable) and instrumental (e.g., function or utility of performing that behavior) (Rhodes, Matheson, & Mark, 2010). This model has been used with young adults drawn from a generally active undergraduate population from previous research (Courneya, 1994; Rhodes, Matheson, & Blanchard, 2006; Rhodes, Matheson, & Mark, 2010), but sedentary young adults have not been examined as of date within the exercise domain with the TPB model. Subjective norms influences behavior through intention and is considered the social pressure on the individual in performing or not performing the behavior. Rhodes & Courneya (2004) indicated that perceived behavioral control (PBC) was the perceived ease or difficulty of performing the behavior by capturing the perceived skills, resources, or opportunities with motivation held positively constant. The TPB encompasses behaviors that are not completely under individual's control thus PBC represents an additional predictor of intention by representing control that is out of the individual's ability (Ajzen, 1991). PBC is considered the ability to perform the behavior (e.g., perceived skills, resources, or opportunities) when motivation is held constant (Rhodes, Matherson, & Blanchard, 2006).

## Scaling Options in Theory of Planned Behavior

The measurement and scaling of response options is important for the validity of the constructs and fundamental to establish robust evidence of physical activity behavior explained by theoretical models and constructs (Rhodes, Matheson, & Mark, 2010). A call for more research at the measurement level suggests the need to assess the variance of the measures based on the scaling format used. The impact that scaling can have on variance at the non-extreme scaling options is mixed (Aiken & Groth-Marnat, 2006). Extreme scaling (e.g. devastating; phenomenal) leads to individuals to prefer to answer the lowest and highest response options thus impacting variance (Thissen-Roe & Thissen, 2013).

To assess theory-based variables a fixed graded measurement is typically used (e.g., 5 times per week over the next two weeks) where it will ask the respondent to grade their response generally from 1-7 (e.g., strongly disagree to strongly agree). Fixed graded measure has also been referred to as dichotomous grading (e.g., cast a vote). Repeated behaviors such as regular exercise correspond better with open measurements (Courneya, 1994). When compared to fix graded measures, open ended measures allows the scale to present exercise in a continuous (e.g., 0-7 in days per week) behavior. The open format utilizes unrestricted response options which allow TPB constructs for exercise intention and behavior to have larger correlations when compared to fix graded (Rhodes, Matheson, & Blanchard, 2006) showing greater measurement accuracy out of all scales (Menon, Raghubir, & Schwarz, 1995). Rhodes, Matheson, & Mark (2010) noted that less work has been done specifically looking at scaling use of constructs performed at the measurement level of the TPB model.

A study conducted by Courneya, Conner, & Rhodes (2006) examined different measurement scales on the variability and predictive validity of the TPB in the exercise domain

while testing the two-component model (i.e., affective and instrumental attitudes, injunctive and descriptive norms, and perceived behavioral control and self-efficacy). The 11-point and the 7-point scales showed the ability to increase the variability of the majority of the TPB constructs, but failed to improve the predictive validity. The two-component model for attitudes and subjective norm did improve the predictive validity of the TPB in the exercise domain. It was recommended from these findings to continue to implement the 7-point scales along with further testing the “two-component” TPB model. Limited measurement gains found by Courneya, Conner, & Rhodes (2006) of providing a scales larger than the 7-point within the exercise domain was also supported by Aiken & Groth-Marnat (2006).

#### Reviews of TPB Response-Sets-based in Exercise and Physical Activity Domains

Courneya (1994) presented a study that looked at the issue of scale correspondence when using repeated behavior of physical activity for one month. They looked at 85 undergraduate students using five different self-report scales (i.e., continuous-open, continuous-closed numerical, continuous-closed verbal, dichotomous-yes/no, and dichotomous-graded). The strongest correlations found were between the continuous-open and continuous-closed numerical scales, and between the two dichotomous scales. In general, the correlations indicated that various scales did render different responses enough to effect the correlations between intended and reported physical activity. From the results, the approach to apply behavior in line with dichotomizing scaling did not appear to be the best solution when items such as intention is used to predict repeated behaviors like as physical activity. Continuous-open or continuous-closed numerical scale is thus recommended when intention is used to predict repeated behavior.

Courneya & McAuley (1994) conducted a study examining two issues of conceptual distinction between intention and expectation and failure to follow scale correspondence when applying the TPB constructs. A total of 170 undergraduates' students completed a self-report measures and follow-up reports at 2 and 4 weeks. The physical activity was assessed on a continuous-open scale by asking the participants the number of times they were physical active, the average duration per bout, and the intensity at which the physical activity bout was performed at 2 and 4 weeks. Both continuous-open and dichotomous scales were used to measure behavioral intention and expectation. When analyzed, the magnitude of the difference between the two correlations was not large. It did explain an additional 9% of variance shared between expected frequency and frequency. The results suggest that future research such investigating the intention-behavior relationship and examine possible explanations for the lack of prediction of physical activity from intention.

Rhodes & Courneya (2005) examined the hypothesized linearity across scale responses in association with intention and behavior when utilizing the TPB model. In this study, they also examined the TPB constructs incremental increases in the proportion of 585 undergraduate students meeting the American College of Sports Medicine's (ACSM) exercise guidelines across the scale responses which no other study had done. Self-report measures were completed by participants along with a 2-week follow up. The ACSM's (2000) recommendation for regular physical activity of activities performed at vigorous intensities three or more times per week for at least 30 minutes bouts was defined for participants when answering the questionnaires'. Exercise attitude was measured with a 7-point bipolar adjective scale (i.e., affective: unenjoyable-enjoyable, boring-interesting, stressful-relaxing; instrumental: useless-useful, foolish-wise, harmful-beneficial) while subjective norm and PBC was measured with a 7-point

scale item (1-strongly disagree to 7-strongly agree; 1-very unconfident to 7-very confident).

Exercise intention was measured on a open scale due to the indication that that continuous-open for repeated health behaviors held the best predictive validity with exercise when compared to other response options.

Exercise behavior was measured with the Godin Leisure Time Exercise Questionnaire (GLTEQ) that contained three open ended questions including the frequency of mild, moderate, and strenuous activities that were completed in free time for at least 30 minutes bouts. All TPB constructs show a significant relationships intention and behavior but post hoc analysis revealed that threshold differences among TPB constructs existed. The results suggested that there were different thresholds on intention and behavior and the ACSM exercise guidelines when related to TPB constructs in the exercise domain. A general trend was supported of linearity across scale responses with a medium correlation found for affective and instrumental attitude on exercise intention and affective attitude on behavior.

Overall small to medium effects were found in regards to instrumental attitude on intention, and subjective norm and PBC on intention and behavior leading to the conclusion that interventions targeting attitudes with a young adult population may have more success in behavior change. The strongest effects in the threshold analysis for any TPB constructs was found with the affective attitude which increased from small effect to medium effect in relation between moderately positive affective attitude and extremely positive attitude on intention. Affective attitude was also the only TPB construct to discriminate proportions of participants following the ACSM (2000) guidelines in a linear path across all response categories. These results indicate that affective attitude can have the greatest effect for behavior change from the moderate to extremely positive levels while continuing to improve behavior outcomes.

In another TPB scaling response study conducted by Rhodes, Matheson, & Mark (2010) investigated the reliability, variability, and predictive validity with 412 undergraduates in the physical activity domain. Two scaling response formats of semantic differential (i.e., measure meaning of things with adjectives; difficult-easy, uncontrollable-controllable) and Likert-type (i.e., 1-strongly disagree to 7-strongly agree) formats along with two different number of response options of 5-point and 7-point. Participants were randomly assigned into four different survey groups ( $n=120$ ). The physical activity definition presented to participants followed the Health Canada's position on activity per week which is performed at least at moderate intensity, 4 or more time per week in 30 minute bouts. The measures were delivered at baseline with the follow-up reported two weeks later. The TPB constructs that were measured were: attitudes (affective and instrumental), subjective norm (injunctive and subjective), PBC, intention, and physical activity behavior through the GLTEQ.

The results showed that all TBP constructs showed differences in variances across all conditions. All TPB constructs were significantly different in reliability when subjective norm was excluded. The 7-point Likert-type response option was significantly larger than all other options when post hoc tests were applied and also showed a significantly larger effect when compared to the semantic differential when the multivariate equation was applied.

Rhodes, Matheson, & Blanchard (2006) further expanded research on scale correspondence in TPB constructs when comparing continuous open and fixed graded scaling within the exercise domain. A total of 420 undergraduates completed the baseline and 2-week follow up measures. They found that both continuous open and fixed closed both showed acceptable variance and reliability, but correlations of the TPB constructs in relation to exercise intention and behavior were larger for continuous open (exercise intention:  $p < .01$ ; exercise

behavior:  $p < .05$ ) when compared to fixed closed considered a medium effect size. When a regression analysis was applied to the continuous open measures, it was noted that higher levels of constructs towards a behavior frequency were required than towards the desired behavior outcome of increased exercise to produce the actual desired behavior.

### TPB Response-Sets-based Summary

The violation of scale correspondence was noted in almost all TPB studies in health behavior due to the repeated nature of the exercise domain and more so when fixed scaling was utilized (Rhodes, Matheson, & Blanchard, 2010). The use of 7-point scaling options have shown to have all TPB constructs exhibit evidence of larger variance indicating that it provides more fidelity to grade one's answer. Though the differences observed in the 7-point scaling response options from increased reliability and variance did not translate to meaningful differences prediction models when comparing 5-point to 7-point options (Rhodes, Matheson, & Mark, 2010). Violation of scale correspondence is the use of dichotomous graded scale for intention when compared to continuous open scale for physical activity (Courneya & McAuley, 1993). Correlations in relation to the TPB constructs utilizing continuous open showed a larger trend with exercise intention and behavior when compared to fixed graded scaling and overall was deemed the superior scaling format. Still not all variance is accounted for. Estimates of physical activity derived from self-report instruments are also prone to measurement errors and biases (Frank et al., 2005; Shepard, 2003; Matthews 2002; Adams et al. 2005; Tucker et al., 2011).

While the work of Rhodes and colleagues shows promise in the predictive validity of continuous open scaling when compared to fixed closed scaling, to date, these relationships have

not been tested within an experimental design. Further, tests of the different scaling options are limited to self-report physical activity.

### *Primary Aims and Hypotheses*

The purpose of this study is to examine the sensitivity to change of the fixed versus open response sets following a brief action planning assessment designed to change TPB related perceptions and increase physical activity in a sedentary population. A secondary aim is improve the prediction of PA of correspondence with self-report and objective PA via accelerometer data gathered. The core features of this study will be applying the TPB constructs to a physically inactive sample while implementing an action plan to increase physical activity in the assessment group with the control group receiving matched-contact time. This theory has been used generally with an active population while only self-report measures were taken. We anticipate that there will be an increase physical activity in the group that was delivered the action plan. Also, there will be a better correlation of intention to exercise with the open-continuous response sets when compared to the fixed response sets validated with operational data.



## *Chapter 2: Theory of Planned Behavior: Item response sets and the prediction of physical activity*

### *Introduction*

The closed response format is fixed at certain frequencies such as individuals that are non-active would agree to disagree more than individuals who are very active. However, the strength of relationships between exercise and TPB constructs is improved when continuous open scales rather than fixed graded scales are used (Courneya, 1994). Further, Rhodes, Matherson, & Blanchard (2006) showed that there was predictive validity improvement by using continuous scale response sets for TPB variables when prospectively predicting self-reported physical activity. There is a need to extend these findings to determine the degree to which fixed versus open response sets predict objectively measured physical activity and to determine the sensitivity to change of the measures using the TPB constructs.

### *Methods*

#### Study Design

The Institutional Review Board (IRB) at Virginia Tech approved of the study. Participants gave their written consent before enrollment into the study and received a copy the consent form along with information for accelerometer wear and activity log. All participants completed a self-reported measure of physical activity (GLTEQ) at baseline along with a TPB 13-item measure assessed using the two response sets of fixed or open. Participants completed the GLTEQ and survey again one and two weeks later. Participants wore an accelerometer on their wrist for the two-week study period and received their accelerometer to wear after they had taken the first survey.

The total time for filling out the questionnaires was less than 20 minutes for each session. At the completion of the first 7 days, participants were randomly assigned to either a personal action planning condition (AP) or a matched-contact control delivered by a research assistant. The control participants received more information on the methods to use the accelerometer, who it collected data, and was reduced into minutes of moderate to vigorous activity. The participants were expected to complete initial baseline gathering (time point 1) and attend 2 sessions over a 2-week period 7 days apart for time point 2 and time point 3. The participants were considered to have successfully completed the study if they came to all three meetings (i.e., baseline, time point 2, and time point 3), wear the accelerometer for the two weeks, and fill out the surveys fully. Monetary compensation was given to participants totaling \$20 in cash after the successful attendance of the three sessions.

#### Target Population, Recruitment, and Eligibility

The target population of young adults aged 18-25 were recruited from the Southwestern Virginian region at Virginia Tech. Research assistants recruited from 4 business courses offered by Virginia Tech and supplemented with recruitment flyers that were hung up within a 5 mile radius of the recruitment area located on campus. Other recruitment methods were used by word of mouth and referral from other participants. This study used a rolling recruitment throughout a spring semester totaling for 14 weeks in which participants were recruited while other participants were on session 2 or had completed the study. Inclusion criteria specified: must be 18 to 25 years old; exercise less than 150 minutes a week; able to perform moderate levels of physical activity. Exclusion criteria: non-English speaking; any contra-indications for physical activity.

### Intervention Description

A 5 A's approach to developing a personal action plan was used with the participants randomly assigned to the AP condition (Estabrooks, Glasgow, & Dzewaltowski, 2003). The 5 A's direct effective physical activity promotion by providing a schematic to guide in developing an action plan tailored to this study by: 1) assess PA, 2) advise health risks/benefits of change, 3) agree, 4) assist in identify barriers and outcomes, 5) arrange follow-up plan. The action plan was delivered with intention to increase the participant's ability to increase their current level of physical activity for one week facilitated by the research assistant. The action plan included strategies to improve physical activity, personal goal setting, and how to overcome obstacles to reach the participants personal goals determined by facilitation from the research assistant.

Two research assistants were trained together for the delivery of the action plan and used several mock trails to standardize facilitation techniques. The research assistant would discuss the personal action plan with the participant and help the participant work through the questions. There were a total of 4 sections centered on physical activity with the action plan and each was intended to focus on a specific TPB construct. Specifically, the sections were titled 1) What motivates me (attitudes), 2) My physical activity goal (intention), 3) My obstacles & strategies (perceived behavioral control), 4) My physical activity plan for the next week. The control group had their data results given to them along with the AP group and received. Accelerometer minutes of moderate to vigorous activity were shared with the participants to facilitate goal setting.

### Physical Activity Assessment

Self-reported physical activity behavior was measured using the Godin Leisure Time Exercise Questionnaire (Godin, Jobin, & Boulion, 1986; Godin & Shephard, 1985). The instrument contained three open-ended questions covering the frequency of mild (e.g., easy walking; minimal effort), moderate (e.g., fast walking; not exhausting), and strenuous (e.g., running; exhausting effort) exercise done during a typical week or 7-day period. The GLTEQ strenuous and moderate physical activity frequencies were aggregated to produce a total activity frequency at or above moderate intensity. Light activity was not included due to the target population's increased standardization of necessity of walking to class that is not considered this study's definition of regular physical activity.

Objective physical activity was assessed using accelerometry. Accelerometers have been found to yield reliable and validated within laboratory and free living settings and allow for collection of various intensities of PA and of sedentary time (Berlin, Storti, & Brach, 2006; Reilly et al., 2008). Accelerometers have been validated with direct observation, self-report measures, energy expenditures measures, and heart rate monitors. Specifically, Actigraph accelerometers performed more accurately with predictions of energy expenditure when compared with the TriTac and BioTrainer which overestimated the energy expenditure by 101%-136% of the measured value (Berlin, Storti, & Brach, 2006). Monitors commonly used are the 7164, the GT1M, and the GT3X, manufactured by ActiGraph (ActiGraph, Pensacola, FL). The majority of research on the TPB is gathered from self-report measures, which has the potential to be confounded by social desirability especially in relation to physical activity (Connor & Armitage, 1998). There is also evidence that cognitive challenge with the accuracy of estimating frequency and duration of physical activity for adults, especially when time period of recall expands a 24-hr period (Shephard, 2003).

The GT3X+ is a tri-axial monitor that measures on three axis that allows for incline detection was used in this study. Incline detection is refers to the ability to track forward and backward movement, up and down movement and the incline. The National Health and Nutrition Examination Survey (NHANES) for 2003-2004 implemented the first objective measures of physical activity in the U.S. population (Masse et al., 2004). Research demonstrated that objective and subjective measures of physical activity outline similarity in results in regards to age and gender patterns but the accelerometer-measured activity was substantially lower when compared to the self-report from the NHANES 2003-2004 data (Troiano et al., 2008). There is an increased need within the literature to validate self-report data with objective data which is gained via accelerometers.

Accelerometer data was analyzed if the accelerometer was worn for 5 of the 7 days. A full day was considered if the accelerometer was worn for 8 hours Wear time was determined by subtracting nonwear time from 24-hr and programed using the Data Scoring system within Actigraph 6 software which automatically removed nonwear time intervals. Nonwear time was defined by an interval of at least 60 minutes no activity intensity counts within allowance for 1-2 min of counts between 0 and 100. Total time in bouts was calculated by ActiLife 6 software which detected the number of occurrences of a bout (or multiple bouts), the average length of the bout(s), and the total time spent in the bouts per week. Only moderate to vigorous activity levels was analyzed in accordance of the recommendation from the CDC that adults obtain 150 minutes of moderate to vigorous intensity activity per week (Physical Activity Guidelines Advisory Committee report, 2008). Cut points from the Freedson Adult VM3 (2011) were set to 2691-6166 counts per minute (CPM) for moderate activity and vigorous<6167 (Sasaki, John, &

Freedson, 2011). Drop Time (per epoch or one minute) was established using time values of 15 minutes, plus or minus two minutes once a bout was initially detected (i.e., 2690 CPM).

Though most studies adopted placement on the waist due to the accelerometer closeness to the center of mass of a whole human body which yields more reliable results of movement, wrist-worn accelerometers were selected as an alternative due to the easier ability of a trial run for participants to wear and ability to conceal the monitor. These factors help facilitate long-term recordings within the young adult population. Research from a study showed that wrist-worn for valid and reliable for estimating energy expenditure and physical activity intensity in children aged 8 to 10 years (Ekblom et al., 2012).

#### Assessment of TPB Constructs

The definition of physical activity was chosen to reflect the Center for Disease Control and Prevention's position stand in the 2008 Physical Activity Guidelines for Americans of 150 minutes (2.5 hours) of moderate-intensity aerobic activity (i.e., brisk walking) per week (CDC, 2012). Fixed graded and continuous open measures were based on prior research done by Rhodes, Matheson, & Blanchard (2006) and Courneya (1994) for response set scaling. With the fixed graded constructs measures, physical activity was defined as exercise activities performed at least at a moderate intensity, 5 or more times per week, for at least 30 minutes bouts each time. Fixed graded response set used a 7-point gradation; agreement of strongly disagree to strongly agree where participants circled the answer that best described their beliefs (See Appendix E).

The continuous open construct measures defined physical activity as exercise activities that are performed at least at a moderate intensity, for bouts of at least 30 minutes each time. Participants were asked to write the frequency of the exercise that would best relate to their

belief of the best representation of them (see Appendix D). The difference noted between the two definitions is thus the frequency of continuous open versus 7-point gradation of advocacy in the fixed graded. Both response sets were pilot tested within a behavioral team meeting ( $N=14$ ) for purpose to test comparability between response sets and comprehension between questions. Input was given for formatting and editing, but all indicated clarity of the questions. Once participants received the questionnaire of either closed/open or open/closed ordering, they then received the same ordering of response sets throughout the study. Though studies have shown ordering of questions may affect responses, it was deemed ordering should remain the same due to analysis of 3 time points.

*Attitude towards moderate exercise* was measured using Rhodes, Matheson, & Blanchard (2006) questionnaire that followed Ajzen & Fishbein (1980) suggestion format of using 7-point bipolar adjectives. Three items (unenjoyable-enjoyable, unpleasant-pleasant, boring-interesting) and another three items (e.g., useless-useful, foolish-wise, beneficial-harmful) were respectively used to tap the affective and instrumental aspects of attitudes (Ajzen, 2002). The questions for the fixed closed were phrased as, “For me, moderate exercise over the next week would be.” The continuous open scaling for attitude used the template set out by Courneya (1994) and modified by Rhodes, Matheson, & Blanchard (2006) with format of answering 0-7 times a week. The three items used to tap affective attitude were 1) “Exercising “blank” (e.g., 0-7) times per week over the next week would be enjoyable,” 2) “It would be pleasant to exercise “blank” times per week over the next week,” 3) “It would be boring to exercise “blank” times per week over the next week.” The three items used to measure instrumental attitudes were 1) “Exercising “blank” times per week over the next week would be useful,” 2) “It would be wise to exercise “blank” times

per week over the next week,” 3) “It would be beneficial to exercise “blank” times per week over the next week.”

*Subjective norm* for the fixed graded measure used three items on a 7-point scale that ranged from 1 (strongly disagree) to 7 (strongly agree). Following the protocol from Rhodes (2006) using Ajzen (2002), two items were used to measure the injunctive component and one item was used to measure the descriptive component of subjective norm. Analyses of these components were aggregated to form a scale based on Rhodes, Matheson, & Blanchard (2006) from findings of Rhodes & Courneya (2003a). The items for fixed closed were 1) “Most people who are important to me want me to exercise regularly over the next week,” 2) “Most people who are important to me do not think I should exercise regularly over the next week (reverse scored),” 3) “Most people who are important to me will exercise regularly over the next week.” Continuous open scaling of subjective norms followed the template used by Rhodes, Matheson, & Blanchard (2006) set by Courneya (1994). The three items used to measure subjective norm were, 1) “Most people who are important to me want me to exercise “blank” (e.g., 0-7) times per week over the next week,” 2) “Most people who are important to me want will exercise “blank” times per week over the next week,” 3) “Most people who are important to me think I should exercise “blank” times per week over the next week.”

*PBC* followed the Rhodes, Matheson, & Blanchard (2006) measure that was previously established in Rhodes & Courneya (2003b, 2004) for the fixed graded scaling on a 7-point range of 1 (very little control) to 7 (complete control) and 1 (not at all) to 7 (very much). The two items used to measure PBC were 1) “How much personal control do you feel you have over exercising regularly in the next week if you really want to? and 2) “How much do you feel that exercising regularly over the next week is beyond your control even if you really want to? (reverse scored)”



The continuous open scaling of PBC followed the same format as the continuous open scales for attitudes and subjective norms. The two items to tap into PBC were 1) “If I really wanted to exercise daily, exercising “blank” (e.g., 0-7) times per week over the next week would be completely under my control,” 2) “Exercising more than “blank” times per week over the next week is beyond my control, even if I were really motivated to exercise every day.”

*Exercise Intention* followed the scaling used by Rhodes, Matheson, & Blanchard (2006) with two items following recommendation from Ajzen (2002). Items followed the same scaling for fixed graded for attitudes from 1 (strongly disagree) to 7 strongly disagree. The two items measured were 1) “I plan to exercise regularly over the next week,” 2) “I intend to exercise regularly over the next week.” The continuous open scaling were 1) “I plan to exercise “blank” (e.g., 0-7) times per week over the next week,” 2) “I intend to exercise “blank” times per week over the next week.

For the ordering of measures, all participants completed the TPB measures using both continuous-open and fixed-closed scales. The order of scales was randomly assigned and stratified by experimental condition.

### Data Analysis

The SPSS version 20.0 was used for all quantitative analyses that were conducted. The data was scored and rechecked by two research assistants using standardized coding protocol. One-way ANOVA was used to examine whether responses on the fixed graded TPB scales were related to continuous open responses. Due to the exploratory nature of the study, we set the significance level for all tests at  $\alpha=0.10$ .

Our hypotheses included: 1) increase physical activity in the group that was delivered the action plan, 2) there will be a better correlation of intention to exercise with the open-continuous response sets when compared to the fixed response sets.

### *Results*

The mean age of the sample was 22.52 years ( $SD=3.72$ ), 71% were female, and the mean years of college was 2.75 years ( $SD=2.89$ ). The block randomization was successful with 46 participants completing the study out of the 53 participants initially recruited. There were 12 participants that completed closed/open questionnaire with the action plan, 12 participants completed open/closed questionnaire with the action plan, 11 participants completed closed/open questionnaire in the control group, and 11 participants completed open/closed questionnaire in the control group. One participant did not complete the survey and was not included in the analyses. There were no significant differences ( $p > .10$ ) between drop-outs and participants sampled on baseline physical activity and TPB variables. A total of 3 participants dropped out from the study after baseline gathering and before session two due to inconvenience of wearing the accelerometer. Accelerometer data from the drop outs were unable to be compared to the baseline data from completed participants due to the incomplete wear time. After analysis of accelerometer wear time, 8 participants data were excluded due to inadequate wear time ( $N=5$ ) and incomplete protocol adherence ( $N=3$ ). Regression models using TBP constructs to predict changes in self-reported and accelerometer-assessed PA were not significant, regardless of scale.

For Table 1, Cronbach's Alpha was tested for all TPB constructs throughout three time points with open and closed compared. Good consistency was found with intention and affective essential had no difference in reliability between open and closed. For instrumental, all scores were adequate ( $\alpha > 0.7$ ) between open and closed but it was noted that open generally more

reliable. Subjective norm in the open survey had a consistent higher score of above  $\alpha < 0.8$  (T1:0.868, T2:0.837, T3:0.928) while closed was above  $\alpha = 0.5$  (T1:0.719, T2:0.681, T3:0.537), but T2 and T3 were below  $\alpha = 0.7$ . In PBC, open showed good consistency for all three time points being above  $\alpha = 0.7$  (T1:0.776, T2:0.903, T3:0.859) while closed failed to reach  $\alpha > 0.7$  (T1:0.450, T2:0.619, T3:0.642).

Table 2 represents the correlations between open and closed scores on the same test construct at each time point. In general responses to the continuous open versus fixed closed items, at each time point, resulted in significantly ( $p < .05$ ) lower perceptions of attitude (open instrumental attitudes T1=4.4, T2=4.2, T3=4.3 versus closed T1= 6.2, T2=6.4, T3=6.3; affective attitudes T1=3.6, T2=3.5, T3=3.9 versus time1= 5.0, T2=5.0, T3=4.8), subjective norm ( T1=3.4, T2=3.3, T3=2.4 versus T1= 5.3, T2=5.2, T3=5.3), perceptions of control ( T1=3.2, T2=3.7, T3=3.9 versus T1= 4.6 T2=4.9, T3=5.2), and intention (T1=1.5, T2=1.8, T3=2.4 versus T1= 4.8, T2=5.1, T3=5.2).

In regards to sensitivity to change, continuous open and fixed closed measures of instrumental attitudes, subjective norms did not demonstrate significant changes as a result of action planning. Affective attitudes measured by the continuous-open scale, but not when measured by the fixed-closed scale, showed change over time regardless of condition. Perceived behavioral control measured using the continuous-open scale increased for AP participants by approximately 0.5 days compared to control participants change of approximately 0.1 days ( $p = .09$ ). A similar pattern was found with intention in that changes in the continuous-open scale were significant (AP=0.9 days; control=0.2 days;  $p = 0.07$ ). No other scales showed significant sensitivity to change. Affective attitude questions were moderately strongly related, with correlations above 0.60 for all time points ( $p < 0.01$ ). Instrumental and Perceived behavioral

control constructs were either not correlated or weakly correlated over time. Subjective norm and intention scores were for the most part moderately correlated over time ( $p < 0.05$ ).

Table 3 shows the repeated measures ANOVA, to investigate significant changes over time in the experimental group versus the control group based on open and closed construct responses, self-report physical activity, and objective accelerometer physical activity minutes. In general, it represents the correlations between open and closed scores on the same test construct at each time point. We found that PBC in open was significant ( $F = 3.070$ ,  $p < .1$ ) and self-report physical activity measures ( $F = 2.851$ ,  $p < .1$ ). The objective physical activity measure was also significant ( $F = 5.407$ ,  $p < .05$ ). Of note, the values tended to be significant in the open format while the closed did not show this trend.

### Change in Physical Activity

The action planning session was successful in significantly increasing accelerometer assessed PA ( $p < .05$ ). Specifically, the action plan baseline physical activity averaged 65 minutes per week while the control group averaged 70 minutes per week. The action plan subsequently showed a significant increase following week two to 107 minutes per week while the control group dropped to 65 minutes per week. Self-reported PA increased significantly for AP participants ( $81 \pm 18$  to  $97 \pm 16$  minutes per week of PA) when compared to control participants ( $87 \pm 19$  to  $75 \pm 17$  minutes per week of PA;  $p < 0.1$ ). Same pattern of differences was shown between AP ( $65 \pm 13$  to  $107 \pm 15$  minutes per week of PA) and control ( $70 \pm 14$  to  $65 \pm 16$  minutes per week of PA) participants ( $p < 0.05$ ) for the accelerometry.

### *Discussion*

The purpose of this study was to compare the sensitivity to change over time within fixed and continuous response sets while objectively measuring PA. The primary aims of this study were to determine 1) the sensitivity to change of TPB constructs using different response sets and self-report and accelerometer assessed PA, and 2) if TPB constructs measured using the different response-sets have differential prediction of PA measured using self-report and accelerometry. The TPB constructs of attitudes, subjective norms, PBC, and intention were chosen from prior research by Rhodes, Matheson, & Blanchard (2006) based on their high occurrence within exercise domain and support by physical activity literature (Symons Downs & Hausenblas, 2005; and Hagger Chatzisarantis, & Biddle, 2002). Continuous open scaling had significant correlations with all constructs along with affective attitude and intention being correlated with the actual reported exercise behavior over fixed graded scaling. This data sheds further insight into the different response sets of the TPB in application to exercise domain within a sedentary, young population. The lack of a significant difference in relation to the TPB constructs and increase in PA may be due to the small sample size.

Courneya (1994) presented a study that looked at the issue of scale correspondence when using repeated behavior of physical activity. Courneya (1994) along with Rhodes, Matheson, & Blanchard (2006) found stronger correlations when utilizing the continuous-open scales which were comparable to our results in that the continuous-open was a superior scaling option than the fixed-closed measures. Of special note, PBC and intention showed significant change within participants in the AP group when compared to the control for the continuous-open scale only. Like the results from Courneya & McAuley (1994), we found a stronger correlation for both intention and physical activity using the continuous-open scale when compared to the fixed-closed. Both studies relate to our findings that fixed-closed trended to violate the scale

correspondence when fix-closed measure of intention was compared to a continuous open scale for physical activity in that the performance of physical activity at a fixed level of at least five times per week was used to predict the frequency or total time of the actual behavior. Rhodes, Matheson, & Mark (2010) comparison of predictive validity of the 7-point closed scale matched our studies findings that the prediction did not translate into reported behavior in the closed responses.

Further research should investigate the role of the personalized action plan utilizing a larger sample size and investigate the correlations of the TBP with intention and actual exercise behavior within interventions. Future efforts to evaluate scaling in the physical activity domain could benefit from investigating the scaling response and/or item phrases in relation to objective data. The study was not free of limitations. Of note, a major limitation to this study was the smaller recruitment size. Another limitation was the utilization of a predominantly college sample comprised primarily of females.

In conclusion, our study findings suggest that the action plan initiative showed significant results in raising physical activity in a sedentary, young population. This research helps fill an important gap in the literature in further exploring different response sets while objectively measuring for the first time the TPB constructs within a sedentary population. Our data confirms the need for additional investigation in the application of the TPB in the exercise domain.

Table 1. Reliability (Cronbach's Alpha) of  
TPB Constructs by Time Point

|                 | Time 1 | Time 2 | Time 3 |
|-----------------|--------|--------|--------|
| Affective       |        |        |        |
| Open            | 0.829  | 0.873  | 0.892  |
| Closed          | 0.767  | 0.882  | 0.922  |
| Instrumental    |        |        |        |
| Open            | 0.908  | 0.916  | 0.951  |
| Closed          | 0.725  | 0.878  | 0.883  |
| Subjective Norm |        |        |        |
| Open            | 0.868  | 0.837  | 0.928  |
| Closed          | 0.719  | 0.681  | 0.537  |
| PBC             |        |        |        |
| Open            | 0.776  | 0.903  | 0.859  |
| Closed          | 0.450  | 0.619  | 0.642  |
| Intention       |        |        |        |
| Open            | 0.965  | 0.948  | 0.978  |
| Closed          | 0.960  | 0.937  | 0.970  |
|                 |        |        |        |

Table 2. Correlations Between Open and Closed By Time

|                               | Time 1 (BL)         | Time 2 (Start)      | Time 3 (Follow-Up)  |
|-------------------------------|---------------------|---------------------|---------------------|
| Affective                     | .610 <sup>***</sup> | .624 <sup>***</sup> | .597 <sup>***</sup> |
| Instrumental                  | .028                | .303 <sup>*</sup>   | .136                |
| Subjective Norm               | .292 <sup>*</sup>   | .658 <sup>***</sup> | .499 <sup>***</sup> |
| PBC                           | .110                | -.189               | -.289 <sup>*</sup>  |
| Intention                     | .488 <sup>***</sup> | .483 <sup>***</sup> | .460 <sup>**</sup>  |
| *.p<.05, **.p<.01, ***.p<.001 |                     |                     |                     |



Table. 3 Follow Up Results By Condition

|                           | Mean (SE) T2  | Mean (SE) T3   | Eta <sup>2</sup><br>(Condition by group) | F       |
|---------------------------|---------------|----------------|--|---------|
| Affective Attitude        |               |                |  |         |
| Open Action Plan          | 3.63 (0.33)   | 4.08 (0.36)    | 0.15                                     | 0.616   |
| Control Closed            | 3.41 (0.33)   | 3.59 (0.35)    |  |         |
| Action Plan               | 4.68 (0.27)   | 4.90 (0.25)    | 0.02                                     | 0.994   |
| Control                   | 4.71 (0.29)   | 4.62 (0.26)    |  |         |
| Instrumental Attitude     |               |                |  |         |
| Open Action Plan          | 4.39 (0.29)   | 4.50 (0.31)    | 0.00                                     | 0.019   |
| Control                   | 3.97 (0.31)   | 4.11 (0.33)    |  |         |
| Closed Action Plan        | 6.18 (0.17)   | 6.14 (0.20)    | 0.00                                     | 0.135   |
| Control                   | 6.56 (0.18)   | 6.41 (0.22)    |  |         |
| Subjective Norm           |               |                |  |         |
| Open Action Plan          | 3.56 (0.33)   | 3.82 (0.36)    | 0.03                                     | 0.660   |
| Control                   | 3.03 (0.36)   | 2.95 (0.38)    |  |         |
| Closed Action Plan        | 5.04 (0.26)   | 5.25 (0.22)    | 0.01                                     | 0.417   |
| Control                   | 5.38 (0.27)   | 5.40 (0.24)    |  |         |
| Perceived Beh. Control    |               |                |  |         |
| Open Action Plan          |               |                |  |         |
| Control                   | 3.85 (0.35)   | 4.33 (0.40)    | 0.06                                     | 2.940*  |
| Closed Action Plan        | 3.45 (0.38)   | 3.36 (0.42)    |  |         |
| Control                   | 4.69 (0.17)   | 4.60 (0.16)    | 0.00                                     | 0.056   |
|                           | 4.74 (0.17)   | 4.71 (0.17)    |  |         |
| Intention                 |               |                |  |         |
| Open Action Plan          | 1.90 (0.25)   | 2.79 (0.30)    | 0.06                                     | 2.793*  |
| Control                   | 1.74 (0.27)   | 2.00 (0.32)    |  |         |
| Closed Action Plan        | 4.81 (0.34)   | 4.81 (0.36)    | 0.01                                     | 0.347   |
| Control                   | 4.79 (0.33)   | 5.05 (0.29)    |  |         |
| Physical Activity Object. |               |                |  |         |
| Action Plan               | 65.00 (12.76) | 107.10 (14.98) | 0.13                                     | 5.407** |
| Control                   | 69.50 (13.79) | 65.06 (16.18)  |  |         |
| SR Action Plan            | 81.00 (17.71) | 96.88 (15.62)  | 0.06                                     | 2.851*  |
| Control                   | 86.91 (18.94) | 75.48 (16.69)  |  |         |
| *p<.1, **p<.05, ***p<.01  |               |                |  |         |

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*Appendices*

**Appendix A: IRB Approval**



Office of Research Compliance  
Institutional Review Board  
2000 Kraft Drive, Suite 2000 (0497)  
Blacksburg, VA 24060  
540/231-4606 Fax 540/231-0959  
email [irb@vt.edu](mailto:irb@vt.edu)  
website <http://www.irb.vt.edu>

**MEMORANDUM**

**DATE:** November 5, 2012  
**TO:** Paul Andrew Estabrooks, Edie Nault, Fabio A Almeida, Kim Saunders  
**FROM:** Virginia Tech Institutional Review Board (FWA00000572, expires May 31, 2014)  
**PROTOCOL TITLE:** Theory of Planned Behavior: Item response sets and the prediction of physical activity  
**IRB NUMBER:** 12-923

Effective November 5, 2012, the Virginia Tech Institutional Review Board (IRB) Administrator, Carmen T Green, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

<http://www.irb.vt.edu/pages/responsibilities.htm>

(Please review responsibilities before the commencement of your research.)

**PROTOCOL INFORMATION:**

Approved As: **Expedited, under 45 CFR 46.110 category(ies) 7**  
Protocol Approval Date: **November 5, 2012**  
Protocol Expiration Date: **November 4, 2013**  
Continuing Review Due Date\*: **October 21, 2013**

\*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

**FEDERALLY FUNDED RESEARCH REQUIREMENTS:**

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

*Invent the Future*

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY  
*An equal opportunity, affirmative action institution*

**VIRGINIA POLYTECHNIC INSTITUTE AND STATE  
UNIVERSITY**

**Informed Consent for Participants  
in Research Projects Involving Human Subjects**

**Title of Project:** Theory of Planned Behavior: Item response sets and the prediction of physical activity

**Investigator(s):** Edith Nault, Kimberly Saunders, Victoria Andersen, Paul A. Estabrooks, PhD, Fabio A Almeida, PhD

**I. Purpose of this Research/Project**

The purpose of the survey is to determine the relationships between your perceptions and physical activity. A secondary purpose is to see if asking you to rate your perceptions in different ways influences how your perceptions are related to changes in physical activity. We are asking for your participation in the study.

**II. Procedures**

In this study, you will be randomized- like a flip of a coin- into an intervention or control group. You will be asked to attend 3, 45-minute meetings over a 2 week period. In the initial meeting you will complete a survey and receive information on wearing an accelerometer (a small device that can be worn on a belt). You will need to wear the accelerometer for two weeks, except for when you shower, bath, or swim. A week later we'll ask you to come back for another appointment during which we will download the accelerometer data, have you complete the survey again and go over your physical activity. The intervention group will also develop a plan for increasing physical activity. In the last meeting (one week later) we will collect the accelerometers and you will be asked to complete the survey one last time..

This study has two potential groups:

1. Group 1—the group will receive a personalized action plan to try and safely increase physical activity for one week.
2. Group 2—will receive the same sessions as Group 1 without the action plan and will not be asked to increase their physical activity.

**III. Risks**

The potential risks in completing the intervention are believed by the research investigators to be minimal. Individuals who have been sedentary may experience discomfort as their bodies adjust



to the demands of physical activity. Neither the researchers nor the university has money set aside to pay for medical or psychological treatment that may be necessary due to your participation in this study.

#### **IV. Benefits**

Your participation in this study is very important and will help us gain knowledge regarding the effectiveness of physical activity questionnaires and improving future physical activity interventions. You will receive information about exercise as well as data gathered from your accelerometer. However, your participation in the study does not guarantee that you will receive health related benefits.

#### **V. Extent of Anonymity and Confidentiality**

Only certified and trained study personnel will have access to information about you obtained for this study. We will use study ID numbers in order to enhance the confidentiality of your information. At the start of the study you will be assigned a study ID number, so that you will only be identified by that number for study purposes. It is possible that the Institutional Review Board (IRB) may view this study's data for auditing purposes. The IRB is responsible for oversight of the protection of human subjects involved in research. All identifiable information about you will be destroyed at the earliest opportunity following the completion of the study.

#### **VI. Compensation**

You will receive \$20 cash after the completion of all three sessions. This includes the completion of the surveys and wearing the accelerometer for the appropriate amount of time.

#### **VII. Freedom to Withdraw**

You are free to withdraw from the study at any time without penalty. However, in order to ensure that our findings are valid, we need to retain at least 75% who sign up for the study. It is expected that you will complete our study survey and wear an accelerometer for two weeks.

#### **VIII. Participant's Responsibilities**

Your participation in this study is voluntary. At a minimum we encourage you to complete the survey and accelerometer data collection, and attend the sessions. If you believe that this may be difficult for you to do, this study may not be right for you.

**IX. Participant's Permission**

I have read the Consent Form and conditions of this project. I have had all of my questions answered. I hereby acknowledge the above and give my voluntary consent:

\_\_\_\_\_ Date \_\_\_\_\_  
Subject signature

Should I have any questions about this research or conduct of the research, I may contact:

|                    |                     |                       |
|--------------------|---------------------|-----------------------|
| <u>Edith Nault</u> | <u>757-848-3895</u> | <u>enault1@vt.edu</u> |
| Investigator(s)    | Telephone           | e-mail                |

|                          |                     |                        |
|--------------------------|---------------------|------------------------|
| <u>Paul A Estabrooks</u> | <u>540-857-6664</u> | <u>estabrkp@vt.edu</u> |
| Investigator(s)          | Telephone           | e-mail                 |

Should I have any questions about the participants' human rights, or in the event of a research-related injury to the participant, I may contact:

|  |                                   |
|--|-----------------------------------|
| <u>David M. Moore</u>  | <u>540-231-4991/moored@vt.edu</u> |
| Chair, Virginia Tech Institutional Review Board for the Protection of Human Subjects<br>Office of Research Compliance<br>2000 Kraft Drive, Suite 2000 (0497)<br>Blacksburg, VA 24060 | Telephone/e-mail                  |



## MY PHYSICAL ACTIVITY ACTION PLAN



Did you know that regular physical activity helps you by ...

- giving you more energy throughout the day;
- allows you to sleep better at night;
- improving your grades and schoolwork;
- boosting your self confidence!



### Step #1: What Motivates Me?

My most important reasons to be physically active are:

---



---

### Step #2: My Physical Activity Goal.

- ✓ How much physical activity am I doing now?  
\_\_\_\_\_ minutes on \_\_\_\_\_ days each week.
- ✓ My goal for this next week is to do:  
\_\_\_\_\_ minutes on at least \_\_\_\_\_ days each week.

### Step #3: My Obstacles & Strategies.

| What Are My Obstacles?<br>(choose your top 1 or 2)   | Strategies to Overcome My Obstacles<br>(write 1 to 2 for each obstacle)   |
|--|---|
| <input type="checkbox"/> Too Tired<br><input checked="" type="checkbox"/> No Time<br><input type="checkbox"/> Bored<br><input type="checkbox"/> Bad Weather<br><input type="checkbox"/> Nowhere To Go<br><input type="checkbox"/> Don't Feel Well<br><input type="checkbox"/> No Support<br><input type="checkbox"/> No Transportation<br><input type="checkbox"/> Other: _____<br>_____ | <input checked="" type="checkbox"/> I will keep track of my exercise regularly.<br><input checked="" type="checkbox"/> _____<br>_____<br><input checked="" type="checkbox"/> _____<br>_____<br><input checked="" type="checkbox"/> _____<br>_____<br><input checked="" type="checkbox"/> _____<br>_____ |



### Step #4: My Physical Activity Plan for Next Week.



| <br>DAY<br>&<br>TIME | ✓ <b>What</b> type of activity I will do.<br>✓ <b>How long</b> I will do the activity.<br>✓ <b>Where</b> I plan to do it & <b>Who</b> I will be active with; or hold myself accountable to do it. |
|---|---|
| DAY: _____<br>TIME: _____   | ✓ <b>What?</b> _____<br>✓ <b>How Long?</b> _____<br>✓ <b>Where &amp; Who?</b> _____   |
| DAY: _____<br>TIME: _____   | ✓ <b>What?</b> _____<br>✓ <b>How Long?</b> _____<br>✓ <b>Where &amp; Who?</b> _____   |
| DAY: _____<br>TIME: _____   | ✓ <b>What?</b> _____<br>✓ <b>How Long?</b> _____<br>✓ <b>Where &amp; Who?</b> _____   |
| DAY: _____<br>TIME: _____   | ✓ <b>What?</b> _____<br>✓ <b>How Long?</b> _____<br>✓ <b>Where &amp; Who?</b> _____   |
| DAY: _____<br>TIME: _____   | ✓ <b>What?</b> _____<br>✓ <b>How Long?</b> _____<br>✓ <b>Where &amp; Who?</b> _____   |
| DAY: _____<br>TIME: _____   | ✓ <b>What?</b> _____<br>✓ <b>How Long?</b> _____<br>✓ <b>Where &amp; Who?</b> _____   |
| DAY: _____<br>TIME: _____   | ✓ <b>What?</b> _____<br>✓ <b>How Long?</b> _____<br>✓ <b>Where &amp; Who?</b> _____   |

### Make A Commitment to Yourself!

The most important thing I will do today is to make a commitment to myself and develop a plan to become more physically active. Over the next week I will talk to \_\_\_\_\_ (name of a supportive friend/family member) about my progress with my physical activity plan.

Appendix D: Open Survey

ID#: \_\_\_\_\_

Date: \_\_\_\_\_

Please take your time to answer the following questions that ask about exercise activities performed **at least** at a *moderate intensity* (for bouts of at least 30 minutes each time). Please circle the response that is provided that best describes you.

---

For example, if a question asks:

**Exercising \_\_\_\_\_ times per week over the next week would be good for my health.**

**(e.g., 0-7)**

Fill in the number of exercise bouts (30 minutes) that best describes the weekly frequency of exercise that you feel would be beneficial to your health

---

1. Exercising \_\_\_\_\_ times per week over the next week would be enjoyable.
2. Exercising \_\_\_\_\_ times per week over the next week would be useful.
3. It would be pleasant to exercise \_\_\_\_\_ times per week over the next week.
4. It would be wise to exercise \_\_\_\_\_ times per week over the next week.
5. It would be boring to exercise more than \_\_\_\_\_ times per week over the next week.
6. It would be beneficial to exercise \_\_\_\_\_ times per week over the next week.
7. Most people who are important to me want me to exercise \_\_\_\_\_ times per week over the next week.

8. Most people who are important to me think I should exercise\_\_\_\_\_ times per week over the next week.

9. Most people who are important to me will exercise an average of\_\_\_\_\_over the next week.

10. If I really wanted to exercise daily, exercising\_\_\_\_\_ times over the next week would be completely under my control.

11. Exercising more than\_\_\_\_\_times over the next week is beyond my control, even if I were really motivated to exercise every day.

12. I plan to exercise\_\_\_\_\_ times for the next week.

13. I intend to exercise\_\_\_\_\_ times over the next week.

---

Appendix E: Closed Survey

Please take your time to answer the following questions that ask about exercise activities performed **at least** at a *moderate intensity*. (5 or more times per week, for bouts of at least 30 minutes each time). Please circle the response that is provided that best describes you.

For example, if a question asks:

**Regular exercise over the next week would be good for my health.**

|                          |                            |                          |                |                       |                         |                       |
|--------------------------|----------------------------|--------------------------|----------------|-----------------------|-------------------------|-----------------------|
| <b>1</b>                 | <b>2</b>                   | <b>3</b>                 | <b>4</b>       | <b>5</b>              | <b>6</b>                | <b>7</b>              |
| <b>strongly disagree</b> | <b>moderately disagree</b> | <b>slightly disagree</b> | <b>neutral</b> | <b>slightly agree</b> | <b>moderately agree</b> | <b>Strongly Agree</b> |

You would circle the response option from strongly disagree to strongly agree that best represents your feelings about whether moderate exercise would be good for your health over the next week.

For me, **moderate exercise over the next week** would be (please answer questions 1-6):

|    |                            |                             |                           |              |                           |                             |                            |
|----|----------------------------|-----------------------------|---------------------------|--------------|---------------------------|-----------------------------|----------------------------|
| 1. | 1<br>extremely unenjoyable | 2<br>moderately unenjoyable | 3<br>slightly unenjoyable | 4<br>neutral | 5<br>slightly enjoyable   | 6<br>moderately enjoyable   | 7<br>Extremely Enjoyable   |
| 2. | 1<br>extremely useless     | 2<br>moderately Useless     | 3<br>slightly useless     | 4<br>neutral | 5<br>slightly useful      | 6<br>moderately useful      | 7<br>Extremely Useful      |
| 3. | 1<br>extremely unpleasant  | 2<br>moderately unpleasant  | 3<br>slightly unpleasant  | 4<br>neutral | 5<br>slightly pleasant    | 6<br>moderately pleasant    | 7<br>Extremely Pleasant    |
| 4. | 1<br>extremely foolish     | 2<br>moderately Foolish     | 3<br>slightly foolish     | 4<br>neutral | 5<br>slightly wise        | 6<br>moderately wise        | 7<br>Extremely Wise        |
| 5. | 1<br>extremely boring      | 2<br>moderately Boring      | 3<br>slightly boring      | 4<br>neutral | 5<br>slightly interesting | 6<br>moderately interesting | 7<br>Extremely Interesting |
| 6. | 1<br>extremely Harmful     | 2<br>moderately Harmful     | 3<br>slightly harmful     | 4<br>neutral | 5<br>slightly beneficial  | 6<br>moderately beneficial  | 7<br>Extremely Beneficial  |

7. Most people who are important to me want me to exercise regularly over the next week.

|                   |                     |                   |         |                |                  |                |
|-------------------|---------------------|-------------------|---------|----------------|------------------|----------------|
| 1                 | 2                   | 3                 | 4       | 5              | 6                | 7              |
| strongly disagree | moderately disagree | slightly disagree | neutral | slightly agree | moderately agree | Strongly Agree |

8. Most people who are important to me do not think I should exercise regularly over the next week.

|                   |                     |                   |         |                |                  |                |
|-------------------|---------------------|-------------------|---------|----------------|------------------|----------------|
| 1                 | 2                   | 3                 | 4       | 5              | 6                | 7              |
| strongly disagree | moderately disagree | slightly disagree | neutral | slightly agree | moderately agree | Strongly Agree |

9. Most people who are important to me will exercise regularly over the next week.

|                   |                     |                   |         |                |                  |                |
|-------------------|---------------------|-------------------|---------|----------------|------------------|----------------|
| 1                 | 2                   | 3                 | 4       | 5              | 6                | 7              |
| strongly disagree | moderately disagree | slightly disagree | neutral | slightly agree | moderately agree | Strongly Agree |

10. How much personal control do you feel you have over exercising regularly in the next week if you really wanted to?

|                     |                |                |         |              |                  |                  |
|---------------------|----------------|----------------|---------|--------------|------------------|------------------|
| 1                   | 2              | 3              | 4       | 5            | 6                | 7                |
| very little control | little control | slight control | neutral | some control | moderate control | Complete Control |

11. How much do you feel that exercising regularly over the next week is beyond your control even if you really wanted to?

|            |                |              |         |          |            |           |
|------------|----------------|--------------|---------|----------|------------|-----------|
| 1          | 2              | 3            | 4       | 5        | 6          | 7         |
| not at all | moderately not | slightly not | neutral | slightly | moderately | very much |

12. I plan to exercise regularly over the next week.

|                   |                     |                   |         |                |                  |                |
|-------------------|---------------------|-------------------|---------|----------------|------------------|----------------|
| 1                 | 2                   | 3                 | 4       | 5              | 6                | 7              |
| strongly disagree | moderately disagree | slightly disagree | neutral | slightly agree | moderately agree | Strongly Agree |



13. I intend to exercise regularly over the next week.

|                      |                        |                      |         |                   |                     |                   |
|----------------------|------------------------|----------------------|---------|-------------------|---------------------|-------------------|
| 1                    | 2                      | 3                    | 4       | 5                 | 6                   | 7                 |
| strongly<br>disagree | moderately<br>disagree | slightly<br>disagree | neutral | slightly<br>agree | moderately<br>agree | Strongly<br>Agree |

---

## Appendix F: Participant Follow Up Email Script

### Email Script Protocol

#### **Interested Participants**

Hello [Name],

Thank you for your interest in the research study. If you are at a low physical activity level (less than 150 minutes a week, preferable 50 minutes or less a week) and between 18-25 years old then I would love to recruit you.

Basically, the first meeting will be me consenting you then you will take a physical activity survey rating your perceptions of physical activity. After which you will wear an accelerometer (tracks movement) on your wrist for 7 days. We meet again, and take surveys/wear the accelerometer for another 7 days. You could be randomized to receive an action plan to increase your physical activity on the second meeting. The third and final meeting I will give you another short survey and \$20 in cash. The study length is a total of only 2 weeks. The second meeting will take place at the CRC (1981 Kraft drive) where I will go over the accelerometer data with you.

If you are interested, please let me know and we will set up a time for the first session.

Thank you,  
[Your Name]

#### **Second Session Reminder**

Hello [Name],

I hope the week has gone well! This coming [Day and Date], please arrive at the Integrated Life Science Building located at 1981 Kraft Drive at [Time]. There is free parking available. Let me know if this time works for you

Make sure to bring:

- accelerometer
- accelerometer tracking log

You will be asked to take several surveys. One of the research assistants will be meeting you in the lobby. This is the [# of session] of 3 sessions. You will be receiving \$20 in cash at your third and final session.

Thank you,  
[Your Name]

### **Third Session Reminder**

Hello [Name],

This is just a friendly reminder that the third and final appointment is this coming [Day and Date] at [Time] in [Place]. Please bring your accelerometer and log sheet. You will be receiving \$20. Let me know if you have any questions.

Thank you,  
[Your Name]

### **Scheduling Follow-Up**

Hello [Name],

Thank you for participating in the Accelerometer Physical Activity Survey Study. Next coming [Day and Date] will be the second of three meetings at the Integrated Life Science Building (also referred to as the CRC) located at 1981 Kraft Drive. If you are available between [give time] then that would be perfect! Let me know what time we can be expecting you or if there is a better time. There is free parking available, and also a bus system that runs up.

Thank you,  
[Your Name]



## RECRUITMENT FOR A STUDY

### **WHERE? WHEN?**

INTEGRATED LIFE SCIENCES BUILDING OF THE CORPORATE RESEARCH CENTER AT  
BLACKSBURG, VIRGINIA. ONGOING RECRUITMENT FOR THE SPRING SEMESTER

We are looking for individuals that are under the CDC recommendation of physical activity (PA) to participate in a research trial at Virginia Tech. The individuals should be physical active 50 minutes or under per week. Minimum time required with 1 starter meeting then meeting once a week for two weeks where questionnaires will be given. Participates will be required to wear an accelerometer. \$20 in cash will be given at the completion of the study.

**PLEASE contact** EDITH NAULT for more info: [enault1@vt.edu](mailto:enault1@vt.edu)



## STUDY OVERVIEW & TIMELINE

---

Thanks for participating in our study! Below is a brief overview & timeline of when we plan to meet and what we are going to do. Hold on to this page for your records. The research assistants will remind you two days before your next appointment with a reminder email.

|                  | TODAY  | WEEK 1   | WEEK 2  |
|------------------|--|--|---|
| <b>DATE:</b>     |  |  |   |
| <b>TIME:</b>     |  |  |   |
| <b>LOCATION:</b> |  | Integrated Life Sciences Building of the Corporate Research Center ( <b>CRC</b> ) on 1981 Kraft Drive  | <b>CRC</b>  |
| <b>AGENDA:</b>   | <ul style="list-style-type: none"> <li>✓ Introduce study</li> <li>✓ Fill out survey &amp; consent form</li> <li>✓ Start wearing accelerometer</li> </ul> | <ul style="list-style-type: none"> <li>✓ Fill out survey(s)</li> <li>✓ Bring back accelerometer &amp; get results</li> <li>✓ Wear accelerometer for 1 more week</li> </ul> | <ul style="list-style-type: none"> <li>✓ Fill out final survey</li> <li>✓ Bring back accelerometer</li> <li>✓ Get \$20.00!</li> </ul> |

### DIRECTIONS FOR WEARING YOUR ACCELEROMETER:

- Please wear the accelerometer for **7 days in a row**, starting the day you receive it. You do not need to start the instrument, it will start automatically.
- The accelerometer is attached to an elastic wrist band that must be worn around your wrist.
- Care and use of the Accelerometer:
  - Wear the instrument only during waking hours.
  - The monitor must be worn snugly against the body at all times.
  - The monitor may be worn underneath clothes if desired.
  - Do not wear it while bathing, showering or swimming.
  - Do not wash or clean the monitor.
  - Do not give it to anyone else to wear!

## Activity Log Instructions

In order to ensure that your physical activity is being properly recorded by the accelerometer, we request that you keep a log of when you wear the instrument, as well as times during which you need to take it off, and specific activities in which you participate that the instrument may not capture completely. Please record the following information on the log during each of the 7 days:

- **Column A:** Write in the DATE under the day of the week. Circle the day you begin wearing the accelerometer.
- **Column B:** Record the time of day when you first put on the accelerometer.
- **Column C:** Record what time you remove the accelerometer at the end of the day.
- **Column D:** Record whether you wore the accelerometer all day or not (Yes or No).
- **Column E:** If NO, record when you took it off and when you put it back on.
- **Column F:** If you did not wear it all day, record why (e.g. took a nap, took a bath, went swimming etc.).
- **Column G and H:** If you ride a bicycle or lift weights, please record the activity in column G and the times of the activity in column H. This is necessary because the instrument is not 100% sensitive to biking and lifting movements.

