PHYSICAL ACTIVITY IN ADOLESCENTS: AN EXPANDED THEORY OF PLANNED BEHAVIOR APPROACH WITH INTERACTION EFFECTS

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ABSTRACT

Obesity in adolescents in the United States has increased at an alarming rate over the past decade, with concerns related to the issue centered around a lifetime of greater prevalence of poor health outcomes for these individuals. Staying active and participating in daily physical activity is one of the key ways adolescents can prevent the onset of obesity early in life and increase physical and mental well-being, despite weight status. As physical activity plays a critical role in the prevention of poor physical and mental health outcomes in adolescents, it is important to understand what factors contribute to a teen's decision to participate in physical activity. One way researchers have historically tried to understand complex decisions is through the use of psychological models. This study uses the Theory of Planned Behavior model, a model commonly used to examine decisions in the health field, to define and explore important factors contributing to physical activity in adolescents or a lack thereof. Additionally, this study expanded the Theory of Planned Behavior model to explore additional relationships among variables in the model and those impacts on physical activity in adolescents. This study uses data collected by the National Cancer Institute for The Family Life, Activity, Sun, Health, and

Eating (FLASHE) study. The data from 1379 individuals was retained for the study. Participants completed up to three surveys pertaining to demographic information, information about diet, and information about physical activity. Results indicated that the original Theory of Planned Behavior Model did not fit the data well. Factors like attitude toward physical activity and perceived behavioral control over one's ability to engage in physical activity were significant; however, the overall model did not accurately explain variations in physical activity. This may be attributed to the unique developmental and environmental circumstances of adolescents compared to the adult population for whom the model was postulated. Results also indicated a significant improvement in the model's ability to explain adolescent physical activity when factors were allowed to covary. Further analysis showed a significant interaction effect between perceived behavioral control and subjective norms on behavioral intent. Results are contextualized and discussed in relation to contributions to research of factors involved adolescent physical activity. Study limitations and future research directions are also discussed.

APPROVAL PAGE

The following faculty members, appointed by the Dean of the College of Arts and Sciences, have examined the thesis titled "Physical Activity in Adolescents: An Expanded Theory of Planned Behavior Approach with Interaction Effects," by Samuel Christopher Nelson, Candidate for the Master of Arts degree, and certify that in their opinion it is worthy of acceptance.

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CHAPTER 1

INTRODUCTION

The Centers for Disease Control and Prevention reported that the obesity rate for adolescents ages 12-19 was 20.6% in 2015 – up 5% from just a decade ago (Hales et al., 2017). At this rate, an estimated 11 million adolescents will be subjected to detrimental, yet entirely preventable, mental and physical health outcomes related to their weight status. Despite rigorous societal efforts and scholarly attention, obesity prevalence has steadily increased for the past two decades with little indication of cessation. The potential causal models of obesity have been hypothesized to be increasingly complex and diverse as research progresses; Researchers have learned that obesity is a multifaceted issue influenced by personal characteristics, environment, culture, and socio-economic status (Chen et al., 2018). Despite our evolving knowledge of adolescent and childhood obesity, many researchers agree that more studies need to be done that focus on understanding the complicated interrelatedness of factors known to influence obesity related behaviors (Bohnert et al., 2020).

In the most basic and concrete derivation, obesity happens when energy intake (calories eaten) exceeds energy expenditure (calories burned) habitually over a period of months or years (Altman & Wilfley, 2014). In this light, an adolescent's physical activity level is of critical importance in determining whether or not he or she will maintain good physical health. Estimates from the World Health Organization conclude that nearly 80% of adolescents do not achieve the daily, recommended 60 minutes of moderate-to-vigorous physical activity (Palmer et al., 2020). It is critically important that adolescents develop healthy habits in regard to physical activity prior to adulthood, as poor physical

health outcomes related to lack of exercise in adult populations are even more prevalent. Additionally, previous studies suggest that it is easier to form healthy habits in youth, rather than work to change unhealthy habits as an adult (Palmer et al., 2020).

Building healthy habits, like regular exercise, is important for adolescents of any weight status, and all adolescents could see health gains from engaging in recommended levels of daily physical activity. Newer frameworks of thinking about physical health interventions emphasize health gains as opposed to weight status, and they acknowledge the complexities of maintaining habits related to good physical and mental health like culture, socio-economic status, and weight-related stigma (Clark et al., 2021).

Developing healthy habits, like exercise, is not always as straightforward as consciously deciding to engage in daily physical activity. Psychologist have investigated human decision-making surrounding complex decisions like engaging in physical activity for decades, uncovering a wide range of factors supported to effect the decision like resources, social influence, and a personal attitudes. A great avenue for understanding decisions regarding physical activity may be to use theoretical models of human behavior (Gourlan et al., 2019). The Theory of Planned Behavior is a highly endorsed theory that explains and predicts human behavior using the context in which it is occurring (Ajzen, 1991). The theory takes into account an aggregation of three main factors to predict context-specific behaviors including attitude toward the behavior, subjective norms, and perceived behavioral control. The theory has been well supported in regard to predicting health related behaviors (Fattahi et al., 2019; McEachan et al., 2011; Muzaffar et al., 2014); however, some scholars have criticized the theory for not including multiplicative interaction effects within the model (Gourlan et al., 2019).

The proposed study will use the Theory of Planned Behavior to predict physical activity levels in a United States national sample of adolescents who participated in the 2014 Family Life, Activity, Sun, Health, and Eating (FLASHE) study, sponsored by the National Cancer Institute. Additionally, the present study will seek to contribute to the conversation around the enrichment of the Theory of Planned Behavior model through the detailed inclusion of several moderating analyses. The goal of this study is to help inform physical activity intervention in adolescents by providing context specific guidance on where to place our attention and resources and why.

CHAPTER 2

REVIEW OF THE LITERATURE

Defining Decision-Making

Value-based decision making has a near constant presence in humans and animals alike; whenever an individual is making a choice between two or more alternatives and placing subjective value on said alternatives, decision-making is taking place (Rangel et al., 2008). Decision-making can be broken down into 5 processes: Representation, Valuation, Action Selection, Outcome Evaluation, and Learning; additionally, there multiple types of valuation systems used to explain decision making as well as moderating factors that affect decision making processes (Rangel et al., 2008). Representation involves identification of action alternatives and internal and external states that may affect valuation of these actions. Valuation concerns assigning value to different actionable alternatives. Action Selection involves incorporating values and choices to come to a decision about what action to take. Outcome Evaluation concerns examining the rewards or consequences of chosen actions to be incorporated in the next decision-making process. Lastly, learning is the process by which Outcome Evaluation in internalized, effecting future decisions.

There are multiple types of valuation systems, and the exact number and nature of these valuation systems is still under investigation (Rangel et al., 2008). At least three types of valuation systems are relevant to this study: Pavlovian systems, Habit systems, and Goal-directed systems. The Pavlovian valuation system reflects valuation based on evolutionarily appropriate responses to particular environmental stimuli or broader approach/avoidance responses. It is important to note that the Pavlovian valuation system

may reflect choices of immediate reward over long-term rewards, and that this valuation process can be interrupted by other valuation systems. Another common type of valuation system is the Habit system. This system reflects learning and changes to action-reward contingencies. Over time this system is able to calibrate specific actions with rewards generated by these actions, forming habits over time. The last type of valuation system discussed is Goal-directed systems; this valuation system can compute expected action-outcome associations as well as predict rewards associated with potential outcomes (even for outcomes that have not yet occurred) (Rangel et al., 2008).

The model to be discussed utilizes all 5 decision-making processes as well as overlapping valuation systems. It is interesting to reflect on how the different valuation systems are employed in the model described below, noting overarching use of Goal-directed valuation as the main determinant of behavioral intent as well as attempts to model inconsistencies between logical action (determined by the use of Goal-directed valuation) and behavior.

Theory of Planned Behavior

The Theory of Planned Behavior (TPB) is a widely supported and utilized theory in behavioral science. Icek Ajzen first derived the behavioral model from his own theory of reasoned action in 1985 (Ajzen, 1985; Schifter & Ajzen, 1985). It is based on a long-standing philosophical assumption that human beings behave in a rational manner. Additionally, the theory assumes that enacted behaviors are the direct result of the individual's intent to engage in the behavior (Ajzen, 2005). However, it is notable that intention will only result in behavior if the person controls the means to enact the behavior at the time of decision. The theory describes behavioral intent as determined by

three different factors, one to encompass the individual, another to reflect social influence, and one to delineate the effect of institutions. Altogether, these variables act in a linear, additive manner to predict context-specific intentions that, in turn, lead to behaviors.

Individual influence in the behavioral decision-making process is inputted into the model as the individual's attitude toward the behavior. The attitude is not general in the sense that it refers to the individual's evaluation of performing a specific behavior (Ajzen, 2005). For example, an individual's attitude toward preforming an exercise himself would be included here, but an individual's attitude toward the idea of exercise would not be included. The attitude toward deciding to do an action of interest is typically described in simple terms as either positive or negative. The individual's valence toward an action is comprised of past experience aggregated to create positive or negative feelings about engaging in the behavior. This principle is notable as it implies that attitude can only predict behavioral intent when both are of equal specificity.

Another determinant of intention in the model is subjective norm, which deals with a person's perception of the social pressure to engage in a behavior of interest. Subjective norms are derived from the likelihood of whether salient individuals in a person's life would approve or disapprove of him/her preforming or not preforming a behavior of interest. Subjective norms are also comprised of the adoption of the behavior by salient individuals in a person's life. This element of the model is often measured by asking respondents to rate the level of performance of a behavior amongst important others (Ajzen, 1991). For example, a researcher may ask a respondent to agree or

disagree with a statement like "My friends play sports." Additionally, subjective norms encompass the attitudes of persons in one's social circle toward a specific behavior.

The last factor that impacts behavioral intent in the model is that of perceived behavioral control. It is clear actual behavioral control is critical for behavior to be enacted; resources and agency most certainly dictate behavior to an extent. However, perceived behavioral control is more in line with Bandura's idea of perceived self-efficacy (Ajzen, 1991). Perceived behavioral control encompasses an individual's judgment of their ability to execute an action under current circumstances, such as the availability of necessary skills, resources, and social support (Ajzen, 2005). For example, if an individual lives two blocks from a gym, he may perceive greater control in his ability to exercise or not than if he lived several miles from a gym. With the perception of greater opportunities or the perception of fewer anticipated obstacles, an individual will be more likely to engage in the behavior of interest.

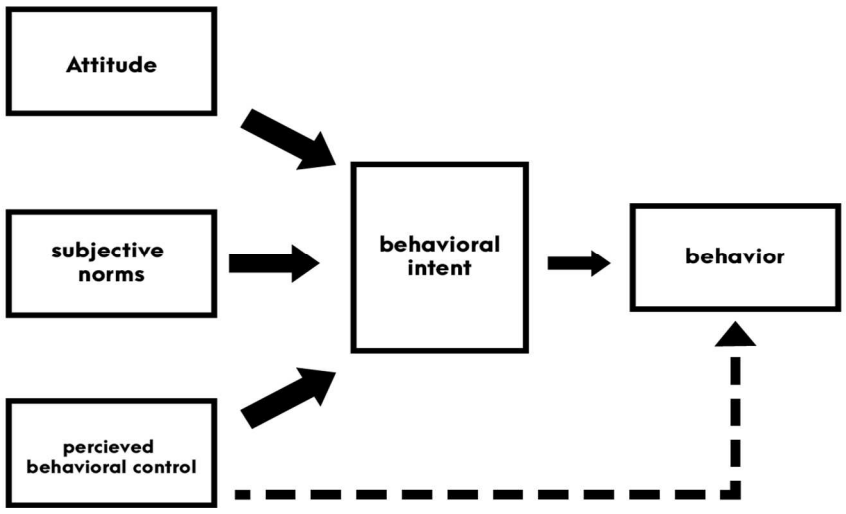
In sum, personal attitude toward the behavior, subjective norms, and perceived behavioral control work together to help explain and predict an individual's behavioral intent and, thus, behavior. When a person evaluates a behavior positively (i.e., positive attitude), has social pressure to engage in the specific behavior (i.e., subjective norm), and believes s/he has the means to enact the behavior (i.e., perceived behavioral control), then the individual's intention to engage in the behavior increases (Ajzen, 2005). As behavioral intent increases, the individual is more likely to enact the behavior of interest. However, this relationship is moderated by perceived behavioral control, suggesting that intentions to engage in a behavior will only result in that behavior if the individual has

adequate resources to carry out the behavior. In this way, perceived behavioral control affects behavior directly as well as indirectly through behavioral intent (see Figure 1).

Ajzen included this relationship in the model to help explain discrepancies seen between behavioral intent and actual behavior in earlier models. Under the assumption that adults are rational and logical beings, Ajzen surmised that this discrepancy between intent and behavior must be due to a concrete lack of resources. While studies have generally shown support in favor of modeling this discrepancy in this way for adult health behaviors, the disconnect between intent and behavior in the model for adolescents could be elucidated further (McEachan et al., 2011). Adolescents are still developing the ability to make deliberate and adaptive decisions, and relationships in the model may differ from how they appear in adults, especially when other developmental contexts, like increased impact of peer influence, are considered (Wolff & Crockett, 2011).

Figure 1

Theory of Planned Behavior Model



Note. Ajzen's original model.

In addition to the relationships shown in the model, it is also theorized that an increase in one element in the model will also increase other factors. For example, if an individual's social group thinks highly of and engages in a lot of hiking, the individual will likely have a more positive personal attitude toward hiking. The interrelationships of factors within the model are not elucidated well and are essentially additive or linear. However, some scholars have criticized the model for this reason (Gourlan et al., 2019). These researchers have called attention to the possibility of non-linear interactions between key variables and plausible threshold effects.

An inclusion of interaction effects would satisfy many critics of the model, although others still would wish to include additional variables. Ajzen suggested that his model was open to further expansion and discourse (Conner & McMillan, 1990). While Ajzen originally predicted an interaction between intentions and perceived behavioral control to predict behavior, there are other interactions not included in the model that have long been the topic of scholarly debate. One such interaction is between perceived behavioral control and attitude on behavioral intent, suggesting that increases in perceived behavioral control may only lead to greater intentions if a threshold of positive attitude toward the behavior is reached (Gourlan et al., 2019). Another prominent proposed addition to the model is an interaction between subjective norms and personal attitude on behavioral intent (Gourlan et al., 2019). This interaction would suggest that a positive attitude is more likely to result in the behavior of interest if the persons in the individual's social circle also preform the behavior and treat it with high regard.

These are just some of the interaction effects that have been hypothesized by researchers. Through a small number of studies, other interactions have been explored

and supported as well (Conner & McMillan, 1999; Gourlan et al., 2019; Hukkelberg et al., 2014; Kothe & Mullan, 2014; McMillan & Conner, 2003; Umeh & Patel, 2004). Despite limited research of interaction effects, the model itself, however, has been the subject of a great deal of research, especially in the field of health psychology (Ajzen, 2005; Fattahi et al., 2019; McEachan et al., 2011; Muzaffar et al., 2014).

Health Related Behaviors and The Theory of Planned Behavior

Researchers with an interest in creating interventions to change the outcome of poor health related behaviors have a great stake in identifying and explaining the factors involved. There are many models that theorize upon the key variables that determine behavior, with TPB among the most widely used and tested – especially in the field of health-related behaviors (McEachan et al., 2011). Wide use of the theory has been attributed to its thorough operationalization and delineation of steps on how to use the theory to measure, analyze, and create interventions. A large meta-analysis of 206 studies on the efficacy of TPB to predict health related behaviors showed strong support for the theory – especial with dietary and physical activity related behaviors (McEachan et al., 2011). Additionally, age was shown to be a moderating factor for several health behaviors - so studying age-specific populations of interest is highly encouraged. Putting criticisms of the model aside, current studies generally support the model's ability to predict health-related behaviors in its current state.

One study designed a physical activity intervention for middle school students using TPB constructs and found significant support for the model to predict intention and behavior, as well as support for interventions designed using the model (Muzaffar et al., 2014). Students in the treatment group underwent five 30- to 40-minute sessions using an

interactive online learning platform designed to improve attitude toward physical activity, enhance perspectives on the social desirability of exercise, and improve perceived opportunities to engage in physical activity. Participants also completed a questionnaire before and after the treatment to assess TPB constructs and physical activity intention. The questionnaire used a variety of scaled items for each of the factors within the model. Researchers analyzed participant responses and used the average of all relevant, scaled items to come up with a score for each factor within the model. Results showed significant ability of model to predict physical activity intention for both the treatment group and the control (Muzaffar et al., 2014). Additionally, the web-based interactive treatment to increase physical activity, which utilized TPB constructs, was found to be significantly efficacious as well.

Another study tested whether or not the TPB model could explain significant variation in a variety of health-related behaviors within the same sample (Murnaghan et al., 2010). Two-hundred eighty-six, predominately white, students ages 12-16 were given two questionnaires a month apart. The questionnaires assessed physical activity, fruit and vegetable intake, and tobacco smoking. The questionnaire given at time 1 measured attitude toward the aforementioned behaviors, subjective norms, perceived behavioral control, and intent. The questionnaire given at time 2 assessed actual behavior related to physical activity, fruit and vegetable intake and tobacco smoking that had occurred in the past month since the first set of questionnaires was given. The researchers assessed the elements of the model according to Ajzen's recommendations: attitude was measured by two Likert scale items for each behavior tested; subjective norm was measured in the same manner asking a question like, "the people most important to me

engage in," said behavior; and perceived behavioral control was also measured in a similar fashion asking about confidence and perceived choice in engaging in the behaviors of interest. A single item asking how often the participant engaged in the behavior over the course of the last month measured their level of behavior. Significant confounding variables such as gender and grade level were controlled for when assessing the predictive capabilities of the model. Analysis showed TPB based models significantly predict behavior, accounting for 25-41% of the variance depending on the behavior of interest (Murnaghan et al., 2010). This study supported the use of TPB to explain physical activity levels in adolescents, as well as several other health behaviors.

Yet another, more recent study, showed similar results in support of TPB. This study was designed to explain and predict physical activity levels in an at-risk population of individuals with type 2 diabetes (Fattahi et al., 2019). 320 individuals, mostly female adults, were randomly selected from a diabetes center to be included in the study. Participants completed a self-report questionnaire with a trained interviewer present to answer any questions. The survey included relevant demographic information, the International Physical Activity Questionnaire (Booth, 2000), and items related to attitude toward physical activity, subjective norm, perceived behavioral control and behavioral intention. Several items were used to measure each construct. Items were mostly in line with Ajzen's recommendations, using Likert scale items to assess each factor in the model. Logistic regression was used to test the significance of the model. The results showed TPB factors were significantly related to physical activity level in patients with type 2 diabetes. Additionally, the study found significant differences in attitude for age and sex.

Many studies have supported the use of the TPB to predict and explain health behaviors – especially physical activity. Additionally, several studies mentioned above elucidated the impact of age on factors within the model. Meta-analysis on the efficacy of the model to predict physical activity has suggested it can explain roughly 24% of the variance in physical activity amongst participants. Despite strong support for the theory, many scholars have pointed out that the model could still be improved upon to explain a greater percentage of the variance in health-related behaviors (Gourlan et al., 2019). Many researchers have focused on the inclusion of interaction terms between variables already in the model as a way to improve upon the theory.

Inclusion of Interaction Terms in Predicting Health-Related Behaviors

Of the research conducted with the goal elucidating interaction effects within the TPB model, several studies have been done on behaviors within the health domain. These studies are done in order to better explain critical human behaviors that affect one's physical health; It is hoped that this knowledge will aid health professionals in developing precise, effective, and efficient interventions that will help reduce the cost of resources and time needed for care.

One study investigated the efficacy of the TPB model to explain cannabis use in adults and tested several hypothesized interactions between model variables (Conner & McMillan, 1999). The study included 249 college students living in the United Kingdom, generally between the ages 19-22. TPB constructs were measured via a survey given at the time of recruitment and again for a three-month follow-up. Constructs were measured using Likert scale items. For example, perceived behavioral control was measured in part on a 7-point scale stating "If I wanted to, I could easily use cannabis/marijuana in the

next 3-month period, extremely unlikely - extremely likely," (Conner & McMillan, 1999). Behavioral intention and behavior were measured in terms of frequency. Statistical analysis supported the TPB model, explaining 71.1% of the variance in cannabis consumption behavior. Several interaction effects within the model were evaluated, and two were found to be significant. A significant interaction was found for attitudes on perceived behavioral control ($p < .001$). The way in which the two interact may imply that much of the predictive power of perceived behavioral control dissipates when negative attitudes are present. Another significant interaction was found between attitude and subjective norms ($p < .001$). The nature of this interaction may imply that attitudes are more likely to predict behavior if perception of social norms are more positive than negative.

In an effort to bolster previous findings, the TPB model was tested to predict the use of variety of substances including LSD, amphetamine, cannabis, and ecstasy over a six-month period in adults (McMillan & Conner, 2003). Potential interaction terms were also assessed. The study had 460 adult participants recruited from a university setting. The participants completed two questionnaires, one at the time of recruitment and another after a six-month period. The questionnaires were constructed in a very similar fashion in comparison with their aforementioned experiment (Conner & McMillan, 1999). Findings from their analysis suggest that the TPB model to be efficacious in predict substance use in all substances of interest. Additionally, a significant interaction between attitude and perceived behavioral control on intention was found across substances. When an individual evaluated the use of a substance as more positive, the availability of the substance generated greater intent to use; however, when evaluations of the use of the

substance were more negative, perceived ability to engage in drug use did not affect intent to use (McMillan & Conner, 2003).

Another study on TPB and ecstasy use in college students revealed similar patterns (Umeh & Patel, 2004). The researchers hypothesized that attitudes, subjective norms, and perceived behavioral control would all moderate each other within the predictive model. Their study sampled 200, predominantly white, undergraduate students between the ages of 18 and 30. A 41-item questionnaire was used to assess TPB constructs as well as other potentially relevant variables. The items were constructed according to Ajzen's operationalization of TPB constructs, with slight modifications in wording and specificity to reflect ecstasy usage behaviors (Umeh & Patel, 2004). Analysis found the basic model to be significant, predicting 64.2% of the variance ($p <$ .0001). When a perceived behavioral control by attitude interaction term was included in the model, the term was found to be significant ($p < .01$) and the model explained an additional 5% of the variance. Slope analysis supported previous findings, showing that perceived behavioral control could lead to increased drug consumption only if the individual evaluated the behavior in a more positive light.

More recently, the applicability of the TPB model to explain another health-related behavior – smoking cessation – was tested in adolescents and adults (Hukkelberg et al., 2014). The researchers were interested in using interaction terms to enhance the model and explain more of the variance in smoking cessation behaviors. The data was derived from a sample of 939 smokers between the ages of 15 and 74, recruited via newspaper advertisements. The subjects completed one survey at the time of enrollment and another four months later for follow-up. Attitudes, subjective norms, perceived

behavioral control, and intention were measured according Ajzen's recommendations. Behavior was coded differently because the researchers wanted to be able to take note of individuals who quit smoking but started up again within the four-month period (Hukkelberg et al., 2014). Results showed strong support for the model as well as two interaction effects. An interaction between attitude and subjective norm was significant such that the positive effect of attitude on intention and behavior was stronger when the individual's social environment also supported smoking cessation. Additionally, the study supported the interaction between attitude and perceived behavioral control on intention; perceived behavior control only increases the behavioral intent if a more positive attitude is present.

Another study used a modified version of TPB to study eating behavior in young adults. Specifically, this study investigated whether including interaction terms within the model would increase the ability of the model to predict fruit and vegetable consumption (Kothe & Mullan, 2015). The study was analytical in nature and used data previously collected by the authors for a similar study in which questionnaires were designed specifically for the purpose of evaluating the TPB model. The data set consisted of 460 participants between the ages of 18 and 25. Without the interaction terms, the model was found to be significant, along with all three predictor variables. With the addition of three interaction terms (Attitude*Subjective Norm, Attitude*Perceived Behavioral Control, and Subjective Norm*Perceived Behavioral Control), the model explained significantly more of the variance in fruit and vegetable consumption ($R2\Delta = 0.022$, $p < .001$). The attitude and perceived behavioral control interaction was found to be significant, supporting the idea of a boundary condition for perceived behavioral control contingent

upon positive attitude. However, contrary to their hypothesis, an interaction between subjective norm and perceived behavioral control was not found.

Most recently, interactions within the TPB model have been explored in the exercise domain in young adults (Gourlan et al., 2019). The study was of longitudinal design with two testing points over a three-month long period. Standard measures of TPB constructs were used for all factors within the model. Six-hundred twenty young adults received and returned the questionnaires by mail. The model was found to be significant without the interaction terms included ($p < .001$); however, the model was also significant and explained significantly more of the variance when interactions between variables were included ($R2\Delta = 0.03$, $p < .001$). The interactions included in the model were perceived behavioral control by attitude (significant), perceived behavioral control by subjective norms (significant), and attitude by subjective norm (insignificant). Of note, perceived behavioral control positively predicted exercise intent across all levels of subjective norm, but the relationship between perceived behavioral control and exercise intent was significantly stronger with high levels of social support (Gourlan et al., 2019).

Study Aim

Alarming obesity prevalence and poor physical health outcomes among adolescents as well as the extreme lack of physical activity in adolescents has drawn the attention of scholars from many different academic disciplines for decades. Research targeted at alleviating the obesity epidemic in adolescents has held a wide breadth of focuses including eating behaviors, physical activity, health education, health justice and other interventions. Refinement of critical knowledge in these areas is of the upmost

importance, especially for interventions as these are cost and labor intensive. In the health field, having theory-based interventions is important, and theories that help to explain behavior should be elaborated upon to describe and understand processes behind behaviors of interest (Lippke & Ziegelmann, 2008). The overarching objective of this project is to aid in the fight against poor physical health outcomes in adolescents by elaborating upon a behavioral model known to explain various health behaviors in adults and adolescents (McEachan et al., 2011). The goal of this project is to increase the efficacy of physical activity interventions through a better understanding of the decision-making process that surrounds physical activity in adolescents.

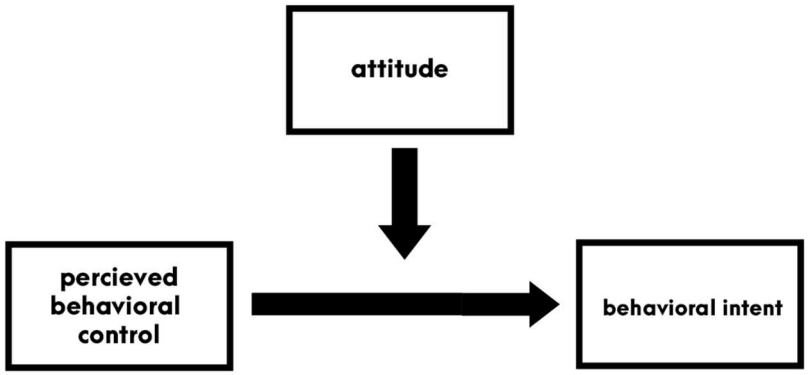
Hypotheses

Hypothesis One

H1: Based on previous studies, it is hypothesized that attitude will moderate the relationship between perceived behavioral control and physical activity intent in adolescents, such that perceived behavioral control will have a greater positive impact on exercise intent when attitudes toward physical activity are positive (see Figure 2).

Figure 2

Perceived Behavioral Control by Attitude Interaction Model

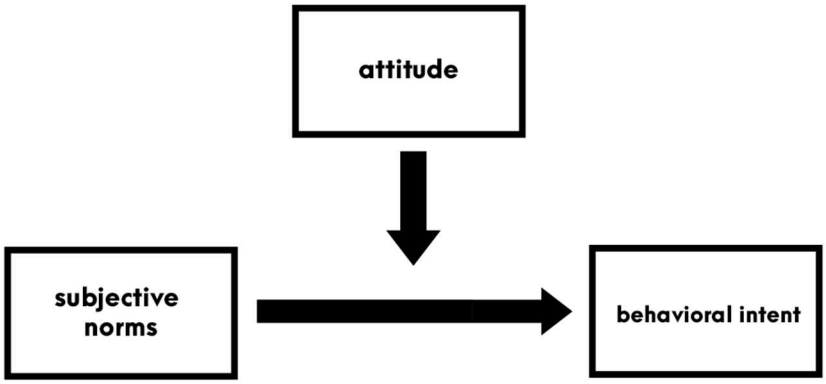


Hypothesis Two

H2: In line with some previous research, an interaction between attitude and subjective norm on physical activity intention in adolescents is hypothesized to be present (see Figure 3). It is thought that positive social pressures may not lead to greater exercise intent, when attitude toward physical activity is notably low.

Figure 3

Subjective Norms by Attitude Interaction Model

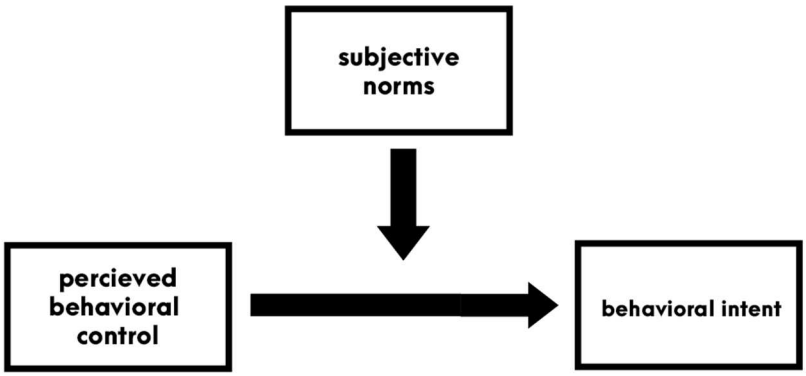


Hypothesis Three

H3: Based on limited research findings, it is expected that subjective norms will moderate the relationship between perceived behavioral control and physical activity intentions in adolescents (see Figure 4). It is hypothesized that the effect of perceived behavioral control on exercise intent would be stronger when positive social support regarding physical activity is present.

Figure 4

Perceived Behavioral Control by Subjective Norms Interaction Model

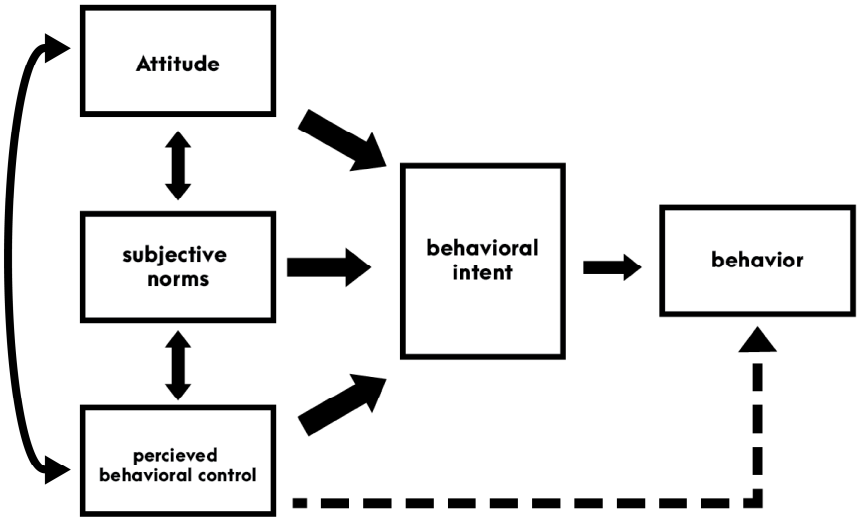


Hypothesis Four

H4: Supported by previous health behavior related research on proposed interaction terms within the TPB model, it is hypothesized that the addition of intercorrelating relationships to the model would explain a statistically greater proportion of the variance in physical activity behavior over and above the additive combination of each variable (see Figure 5).

Figure 5

Expanded Theory of Planned Behavior Model with Intercorrelations



Note. Model shows additional relationships among variables not included in figure 1.

CHAPTER 3

METHODOLOGY

FLASHE Data Set

Data for analysis was retrieved from The Family Life, Activity, Sun, Health, and Eating (FLASHE) study done by the National Cancer Institute between April and October of 2014 (Cancer.gov). The original purpose of the study was to aid in the understanding of behaviors linked to cancer risk. While the surveys measured psychosocial, adolescent-parent dyad, and environmental correlates of cancer related behaviors, most of the questions gathered information on physical activity and diet in both parents and their adolescent offspring. Since the publication of FLASHE data set in 2016, a large volume of health-related research has been generated through analysis of the data.

Participants were sampled from a Consumer Opinion Panel and paid up to $10 for each survey completed. Three web-based surveys were administered: one for demographic information, one for diet, and one for physical activity. Participants were evaluated by the National Cancer Institute to be representative of the general United States population on sex, education, income, age, household size, and region. Subjects were dyads of children ages 12-17 and one of their randomly selected caregivers. A total of 1,479 adolescents completed the survey pertinent to their own physical activity. The survey covered a vast array of factors related to physical activity including but not limited to personal and socially perceived attitudes toward exercise, physical activity practices by salient others, perceptions of opportunities to engage in physical activity, as well as intentions to engage and engagement in physical activity.

Measures

While the data for this study was originally collected to assess potential risk factors for certain cancers and not designed to measure Theory of Planned Behavior constructs, it lends itself well to the present study. In the present study, items from the physical activity questionnaire were used to measure the model's constructs align closely with published guidelines (Francis et al., 2004). There are at least the minimum number of items needed to accurately reflect all TPB constructs, items are Likert scales using bipolar, evaluative adjectives, and items are varied in terms of negative/positive endpoints. Seven-point scales are recommended; however, the physical activity survey uses 5-point scales. The sample size is large enough to meet widely accepted rule of thumb criteria of at least 10 cases per indicator for nonnormal data (>150; Westland, 2010).

Teen Physical Activity Survey (Nebeling et al., 2017) is a comprehensive self-report measure related to teen physical activity practices, attitudes and culture. This measure represents extensive work by the National Cancer Institute to combine existing validated and reliable measures into a single, efficient survey. A team of 19 scientific advisors were involved in this phase of the FLASHE study, using their expertise to select questions from validated and well-established measures to create the Teen Physical Activity Survey; new items were developed, or items were modified if a validated measure could not be found in the literature by the FLASHE study team. The constructs of interest to the FLASHE study team were represented by single or few questions, pulled from other questionnaires, to reduce respondent burden given the extensive scope of the information collected. Due to this, assessing validity and reliability of items used in the

present analysis is difficult, but a review of the origin of each question used will proceed. Items were pulled from the Teen Physical Activity Survey to represent concepts relevant to the present analysis by comparing questions available in the FLAHSE data base to questions used by researchers who have previously studied the theory of planned behavior in health-related contexts; this assessment of items used to reflect constructs of interest in the present study was largely an assessment of face-validity.

For this study, two items were selected to measure attitude toward physical activity. Items were responded in a 5-point scale from "*strongly disagree*" to "*strongly agree.*" Items were coded so that higher scores are associated with a more positive attitude toward physical activity (see Appendix for list of items used for analysis). The average score of two items indexed each adolescent's attitude toward physical activity. Item 1 ("During a typical week, I don't like to exercise") was used for measuring attitude toward physical activity in adolescents in Resnicow and collogues' study (2005). The researchers did not speak to validity and reliability of their self-designed questionnaire but found it applicable to their sample of overweight African American adolescent females (Resnicow et al., 2005). Item 2 ("If I were to be physically active most days of the week, it would be fun") was used by Motl and collogues (2000) to measure attitude toward physical activity. The researchers sought to create valid and reliable questionnaires on attitude, subjective norms and perceived behavioral control related physical activity in adolescent girls. When Motl and collogues reduced their questions about attitude from 22 to 8 items, the final model possessed acceptable fit (chi-squared = 47.36, $df = 20$, RMSEA = 0.037) and factor loadings for each question were small to medium (M = 0.51) (Motl et al., 2005).

In the present study, four items were selected to measure subjective norms concerning physical activity. Items were responded to with a 5-point scale ranging from "*strongly disagree*" to "*strongly agree.*" Items were coded so that higher scores are associated with more positive subjective norms toward physical activity. The average score of four items indexed each adolescent's subjective norms surrounding physical activity. Item 1("During a typical week, my friends exercise most days of the week") was sourced from Norman and colleagues (2005). The researchers reported the reliability for their five questions related to peer influence on physical activity to have an alpha of 0.6 (Norman et al., 2005). Item 2 ("During a typical week, my family doesn't like to exercise") was pulled from work done by Resnicow et al. (2005), with little discussion of item reliability or validity. Item 3 ("I would exercise most days of the week because others would be upset with me if I didn't") was sourced from the Treatment Self-Regulation Questionnaire as used by Levesque and colleagues (2007). Extensive information about the reliability and validity of questionnaire items are provided, indicating excellent model fit and significant factor loadings. Additionally, items correlated highly with other validated measures (Levesque et al., 2007). Item 4 ("My parent(s) try to be physically active when I am around") came from the Activity Support Scale as validated by Davison and colleagues (2010). Their research supported the scales internal reliability and indicated applicability for both Black and non-Hispanic White parents (Davison et al., 2010).

For this study, two items were selected to measure perceived behavioral control in being physically active. Items were responded in a 5-point scale from "*strongly disagree*" to "*strongly agree.*" Items were coded so that higher scores are associated with greater

levels of perceived behavioral control. The average score of two items indexed each adolescent's perceived behavioral control in being physically active. Item 1("My parent(s) take me places where I can be physically active") used to measure perceived behavioral control was collected from work done by Davison and colleagues, 2010 – mentioned previously. Item 2 ("I feel confident in my ability to exercise regularly") was sourced from the Self-Determination Theory's Perceived Competence Scales. The website cites two studies that have used the scale and found the alpha for internal consistency to be greater than 0.80 (Perceived Competence Scales).

In the present study, one item (per recommendations) was selected to measure intention to be physically active. The item was responded to with a 5-point scale ranging from "*strongly disagree*" to "*strongly agree.*" The item was coded so that higher scores are associated with greater intent to be physically active. An adolescent's response to this item indexed their intent to be physically active. This item ("I would exercise most days of the week because, I have thought about it and decided that I want to exercise") was sourced from Levesque and colleagues, 2007 – mentioned previously.

Lastly, engagement in physical activity was measured in predicted weekly minutes of moderate-to-vigorous activity; the FLASHE study team, using a large number of items indicating time spent by the individual doing specific active and sedentary behaviors, calculated and provided this number. This estimation procedure comes from work done by Saint-Maurice & Welk, 2015. The researchers demonstrated high group-level correlations between actual physical activity and self-report, with average error between 15 – 20% (Saint-Maurice & Welk, 2015).

Statistical Analysis

All analyses were conducted using AMOS Graphics and IBM SPSS Statistics (Version 27.0). Path analysis with maximum likelihood estimation was used to examine the data via the theoretical models of interest. Outliers were not identified in the data (univariate, $z > \pm 3.0$; multivariate, Mahalanobis distance $p < .001$) and bootstrapping was used to address non-normality of variables for path analysis models, so other methods of estimation were considered but not employed. Two Path analysis models were compared; the first model did not allow correlations between indicators of behavioral intent to engage in physical activity while the second model did (See Figures 1 and 5). Both models were recursive in that there were no feedback loops. Latent variables were set to scale in both models, and degrees of freedom were greater than zero for both models as well ($df_1=5$, $df_2=2$). Due to these reasons, the models were said to be theoretically identified.

Model fit for each model was evaluated in four different ways: comparative fit index (CFI), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), and Chi-squared values. Judgments were made about fit indices using conventional means; CFI values above .95, RMSEA and SRMR values at or below .08, and non-significant chi-squared values indicate adequate fit (Hooper, Coughlan, & Mullen, 2008). While chi-squared values were being examined, they were emphasized less than other global fit indices due to this index's hypersensitivity to minor variations from model fit in complex models with large samples (Andrich, Sheridan, & Luo, 2009). Models were compared to each other using a Chi-squared difference test. Finally, regression analysis was performed in order to determine the significance of moderation

terms identified in hypothesis one through three; significance will be evaluated at the $p \leq .05$ level.

CHAPTER 4

RESULTS

Preliminary Analyses

While 1479 adolescent/parent dyads completed the study in its entirety (three separate surveys), 1661 adolescents filled out at least one item in the Teen Physical Activity Survey. 1379 individuals were retained for the final analysis (16.9% missing data). Casewise deletion was used to delete any cases that were missing a value relevant to the analysis. Casewise deletion was chosen as the method of addressing missing data as most participants who failed to respond to an item corresponding to a construct of interest did not respond to the vast majority of items. Many individuals appeared to begin filling out the form and stopped less than five questions in, perhaps due to the extensive nature of the surveys.

The data was found to be nonnormal, with all variables displaying a positive skew, by visually assessing histograms and evaluating kurtosis values. Bootstrapping was used for path analysis models instead of transforming the data because data transformation would make model interpretation difficult at best. Additionally, bootstrapping helps to ensure greater generalizability of study results, mitigating some of the issues to representativeness of the sample brought on by a large number of deleted cases. See Tables 1 and 2 for descriptive statistics of model variables as well as estimated variances, covariances and correlations.

Table 1. Descriptive statistics for Model Variables (*N*=1379)

	Mean (*SD*)	Min	Max
Attitude	3.88 (0.95)	1	5
Subjective Norms	3.28 (0.76)	1	5
Perceived Behavioral Control	3.77 (0.96)	1	5
Behavioral Intent	3.79 (1.05)	1	5
Physical Activity (minutes/week)	572.47 (109.19)	356.58	915.84

Table 2. Estimated variances, covariances[a], and correlations[b] (*N*=1379)

	Variance	*SE*	1	2	3	4	5
Attitude (1)	0.99	0.04	1	0.25	0.48	0.50	26.13
Subjective Norms (2)	0.58	0.02	.35	1	0.40	0.27	20.35
Perceived Behavioral Control (3)	0.92	0.04	.53	.54	1	0.44	31.05
Behavioral Intent (4)	1.10	0.03	.50	.34	.44	1	15.60
Physical Activity (5)	11922.40	413.89	.25	.25	.30	.14	1

Note. All correlations were significant at the .01 level (two-tailed).
a. Covariances are located in the upper echelon.
b. Correlations are located in the lower echelon.

Hypothesis One

Hypotheses 1, 2, and 3 examined relationships between predictor variables and behavioral intent in order to gain a better understanding of how model variables come together. Hypothesis 1 (H1) addressed the prediction that attitude would moderate the relationship between perceived behavioral control and physical activity intent in adolescents. Specifically, it was hypothesized that perceived behavioral control would have a stronger positive impact on exercise intent when attitude toward physical activity was positive. Prior to conducting the moderation analysis, variables in the analysis were centered and an interaction term between attitude and perceived behavioral control was

created. The interaction between attitude and perceived behavioral control on behavioral intent was found to be insignificant (B = 0.01, p = .687, β = 0.01).

Table 3. Regression Model for Hypothesis One

	Unstandardized Coefficients		Standardized Coefficients			Correlations		
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part
(Constant)	-0.005	0.027		-0.176	0.860			
Perceived Behavioral Control (centered)	0.269	0.029	0.245	9.143	0.000	0.439	0.239	0.208
Attitude (centered)	0.401	0.030	0.364	13.369	0.000	0.496	0.339	0.304
Interaction Term	0.010	0.024	0.010	0.403	0.687	0.159	0.011	0.009

Dependent Variable: Behavioral Intent

Hypothesis Two

Hypothesis two (H2) examined the prediction that attitude would moderate the relationship between subjective norms and physical activity intent. Moreover, it was thought that positive social pressures would have a weaker positive effect on physical activity intentions with attitudes toward physical activity were lower. Prior to conducting the moderation analysis, variables in the analysis were centered and an interaction term between subjective norms and attitude was created. The interaction between subjective norms and attitude on behavioral intent was found to be insignificant (B = 0.017, p = .585, β = 0.013).

Table 4. Regression Model for Hypothesis Two

	Unstandardized Coefficients		Standardized Coefficients			Correlations		
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part
(Constant)	-0.004	0.025		-0.167	0.867			
Attitude (centered)	0.471	0.027	0.427	17.182	0.000	0.496	0.420	0.394
Subjective Norms (centered)	0.263	0.034	0.191	7.797	0.000	0.339	0.206	0.179
Interaction Term	0.017	0.031	0.013	0.546	0.585	0.097	0.015	0.013

Dependent Variable: Behavioral Intent

Hypothesis Three

Hypothesis three (H3) looked at the prediction that subjective norms will moderate the relationship between perceived behavioral control and physical activity intentions in adolescents. Furthermore, is was hypothesized that the positive effect of perceived behavioral control on exercise will be stronger when the individuals is surrounded by positive social support regarding physical activity. Prior to conducting the moderation analysis, variables in the analysis were centered and an interaction term between perceived behavioral control and subjective norms was created. The interaction between perceived behavioral control and subjective norms on behavioral intent was found to be significant (B = -0.076, p = .015, β = -0.061). This result suggested that the positive impact of perceived behavioral control on behavioral intent is weaker as subjective norms increase. While the interaction between these variables was hypothesized, it is in the opposite direction of what was expected. Noting that perceived behavioral control includes both resources and efficacy related perception, it is possible that increased parental involvement (reflected as greater subjective norm scores) may

decrease the impact of knowing how to exercise on one's own (perceived behavioral control) on behavioral intent to exercise.

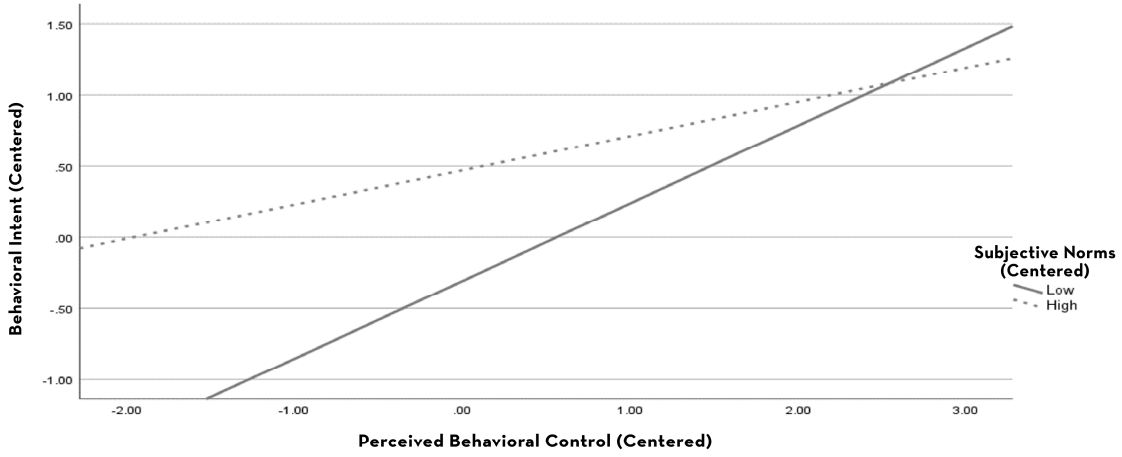
Table 5. Regression Model for Hypothesis Three

	Unstandardized Coefficients		Standardized Coefficients			Correlations		
	B	Std. Error	Beta	t	Sig.	Zero-order	Partial	Part
(Constant)	0.030	0.028		1.080	0.280			
Perceived Behavioral Control (centered)	0.414	0.032	0.378	12.871	0.000	0.439	0.328	0.308
Subjective Norms (centered)	0.194	0.039	0.141	4.930	0.000	0.339	0.132	0.118
Interaction Term	-0.076	0.031	-0.061	-2.443	0.015	0.052	-0.066	-0.059

Dependent Variable: Behavioral Intent

Figure 6

Hypothesis Three Interaction



Hypothesis Four

Assessment of Models

Model 1 (See Figure 1) was a path analysis model in which attitude, subjective norms, and perceived behavioral control loaded onto behavioral intent. Behavioral intent then loaded onto enacted behavior (physical activity); however, this relationship was mediated by perceived behavioral control. Bollen-Stine Bootstrap Chi-squared revealed the model did not fit well globally, $p = .002$. Additionally, all other estimates of model fit used indicated that the model had poor fit in a global sense (CFI=.386, RMSEA=.375, 90% CIs [.356, .395], *pclose* < .001, SRMR=.250). These results suggest that Model 1 as a whole was not efficacious in predicting adolescent physical activity, indicating that the structure of the model needs to change to more accurately reflect the decision-making processes in adolescents over physical activity participation.

In addition to poor global fit, model fit at the local level was poor with 10 large (>2) standardized residual covariances. Factor loadings for each indicator were negligible to medium (.007 - .381). Notably, the largest factor loadings were found for attitude on behavioral intent (.381) and perceived behavioral control on physical activity (.294). These results suggest relationships between variables may not have been hypothesized correctly for this population concerning physical activity engagement. Other variables may be involved or the relationship between variables is not surmised correctly.

Table 6. Parameter Estimates of Model 1 (*N*=1379)

Direct path coefficients		
Path	Unstand.(*SE*)	Stand.
Behavioral Intent ← Attitude	0.393(.029)‡	0.381
Behavioral Intent ← Subjective Norms	0.155(.037)‡	0.120
Behavioral Intent ← Perceived Behavioral Control	0.208(.033)‡	0.203
Physical Activity ← Perceived Behavioral Control	33.46(3.263)‡	0.294
Physical Activity ← Behavioral Intent	0.741(2.979)	0.007

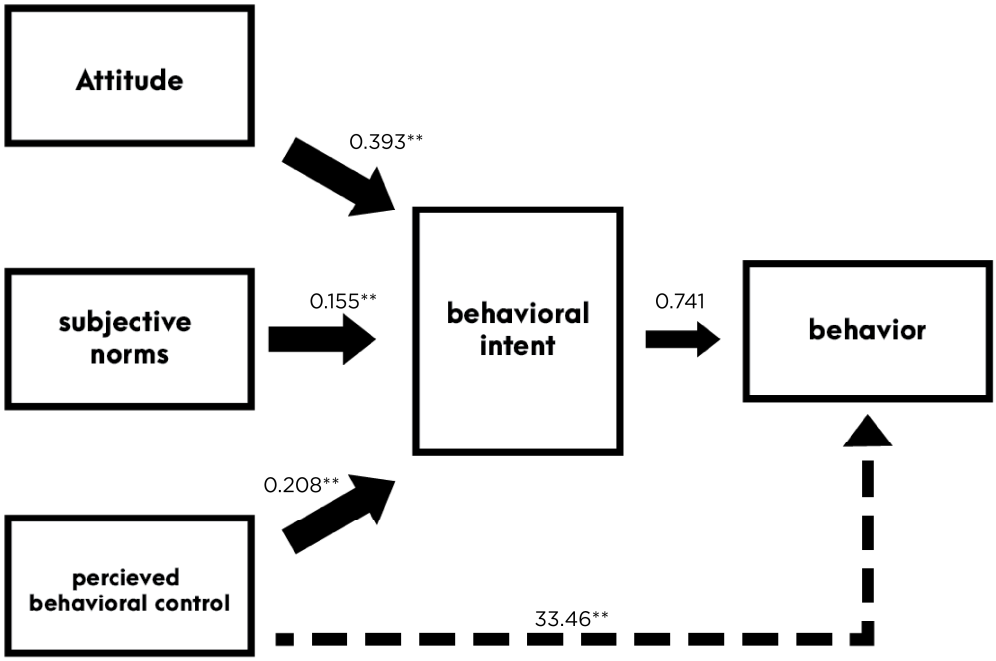
Indirect path coefficients		
Variable	Unstandardized	*r*
Physical Activity ← Attitude	0.291	.003
Physical Activity ← Subjective Norms	0.115	.001
Physical Activity ← Perceived Behavioral Control	0.154	.001

Variances		
Variable	Unstand.(*SE*)	R^2
Attitude	.908(0.035)‡	—
Subjective Norms	.578(0.022)‡	—
Perceived Behavioral Control	.917(0.035)‡	—
Behavioral Intent	.772(0.029)‡	.201
Physical Activity	10864.12(413.89)‡	.087

Note.
**p < .05. † p < .01. ‡ p < .001.*

Figure 7

Unstandardized Beta Weights for Model 1



Note. $^{**}p < .01$

Model 2 (See Figure 2) is identical to Model 1, except that, in this model, attitude, subjective norm, and perceived behavioral control were all allowed to correlate with each other. Bollen-Stine Bootstrap chi-squared revealed the model did not fit well globally, $p = .002$. Given the hypersensitivity of Chi-squared statistics in complex models with large samples, global fit might still be surmised as good depending on fit indices. Other maximum likelihood estimates of model fit indicated that the model was able to fit the data adequately in a global sense (CFI= .979, RMSEA=.109, 90% CIs [.079, .142], *pclose* <.001, SRMR= .032). Although the RMSEA and SRMR indices did not meet the general rule of thumb criteria for adequate fit, the high CFI index might still indicate some theoretical support of the model. The high CFI index shows significant

improvement in the model's ability to explain the data as compared to a nonstructured model. Therefore, Model 2 is closer to being able to describe this decision-making process than no model; however, the degree to which the model preforms in predicting adolescent physical activity is still not significant and does not align with the a priori hypothesis.

There were two large standardized residual covariance between subjective norm and physical activity (3.039) and attitude and physical activity (3.410). Factor loadings for each indicator were highly similar to those of Model 1. Model local fit is adequate but lacking in explanatory power and could likely be improved upon. The results indicate that local fit is improved by allowing variables to correlate with each other; by allowing the variables to correlate with each other, the relationships between variables accounted for more variation in physical activity behavior.

Table 7. Parameter Estimates of Model 2 (N=1379)

Direct path coefficients			Indirect path coefficients		
Path	Unstand.(*SE*)	Stand.	Variable	Unstandardized	*r*
Behavioral Intent ← Attitude	0.393(.029)‡	0.357	Physical Activity ← Attitude	0.291	.003
Behavioral Intent ← Subjective Norms	0.155(.037)‡	0.112	Physical Activity ← Subjective Norms	0.115	.001
Behavioral Intent ← Perceived Behavioral Control	0.208(.033)‡	0.190	Physical Activity ← Perceived Behavioral Control	0.154	.001
Physical Activity ← Perceived Behavioral Control	33.46(3.263)‡	0.294			
Physical Activity ← Behavioral Intent	.741(2.979)	0.007			

Table 7. Parameter Estimates of Model 2 (N=1379)

Direct path coefficients			Indirect path coefficients		
Path	Unstand.(*SE*)	Stand.	Variable	Unstandardized	*r*

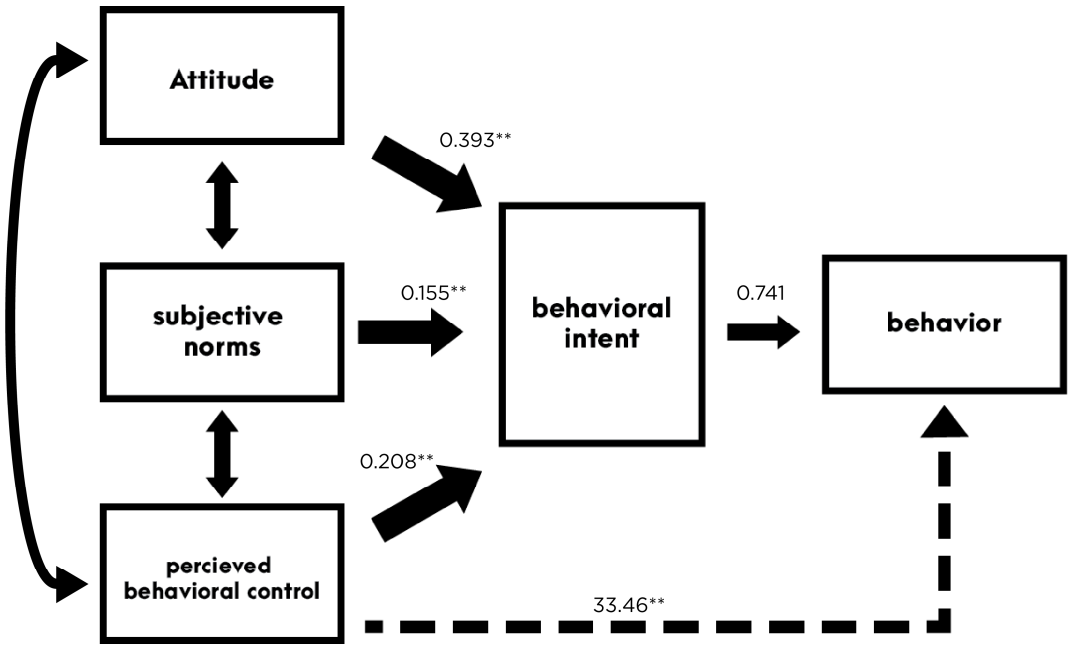
Variances

Variable	Unstand.(*SE*)	R^2
Attitude	0.908(0.035)‡	—
Subjective Norms	0.578(0.022)‡	—
Perceived Behavioral Control	0.917(0.035)‡	—
Behavioral Intent	0.772(0.029)‡	0.299
Physical Activity	10864.12(413.89)‡	0.088

Note.
**p < .05. † p < .01. ‡ p < .001.*

Figure 8

Unstandardized Beta Weights for Model 2



Note. **$p < .01$

Model Comparison

When comparing Model 1 and Model 2, Model 2 outperforms Model 1 in terms of both global and local fit. A chi-squared difference test was utilized to test for significant difference between the models. The models were found to be significantly different ($\chi d^2(3)= 941.37$, $p < .001$). Model 2 is retained as it outperforms Model 1 in terms of global and local fit; additionally, Model 2 is more theoretically sound when it comes to the most recent literature on Theory of Planned Behavior models in the health domain concerning the inclusion of intercorrelational effects. The results support Hypothesis 4, in that Model 2 did outperform Model 1, including increased explanatory power; however, the impact of changes made in Model 2 is small and alternative models should be considered. Within the context of adolescent development, it is interesting to consider that attitude, subjective norms, and perceived behavioral control significantly predicted behavioral intent in the study, but behavioral intent did not significantly load onto actual physical activity behavior. This pattern of results may indicate the model has some efficacy with this population and their decisions to be physically active, but some tailoring to the population may be required.

CHAPTER 5

DISCUSSION

Understanding the impact of factors identified as having an effect on the adolescent's decision to engage in physical activity is critical, given the relationship between lack of physical activity and the early onset of obesity in adolescents (Zhu et al., 2019). Past research has identified a myriad of factors shown to correlate with adolescent engagement in physical activity, but research attempting to model this complex decision is still growing. The purpose behind this study was two-fold: to investigate the applicability of the Theory of Planned Behavior model in explaining variations in physical activity in adolescents and to contribute to scholarly discourse about the inclusion of moderation effects in the Theory of Planned Behavior model. This study provided evidence that the Theory of Planned Behavior may not be the best model for explaining health behaviors in adolescents. For models in this study, factor loadings appear small for most all constructs and overall ability of the model to explain variance in physical activity is relatively low. Despite overall poor model performance, the models did well in predicting behavioral intent for the study sample. Concerning contributions to discourse surrounding the Theory of Planned Behavior, support for the inclusion of moderation effects in Theory of Planned Behavior models from this study is mixed. Results showed a lack of interaction between perceived behavioral control and attitude on behavioral intent as well as attitude and subjective norms on behavioral intent; however, results also showed an interaction effect between perceived behavioral control and subjective norms on behavioral intent. Notably this interaction was small and in the direction opposite of what was expected. There was a small increase in model 2's ability

to explain variance in behavioral intent and an even smaller increase in model 2's ability to explain variance in physical activity. These results indicate that the inclusion of interaction effects may be beneficial, but further investigation is needed.

It is important to consider reasons why the Theory of Planned Behavior model did not perform well with this sample before the results are extrapolated for use in scientific discourse and research. While some reasons may fall into the realm of study limitations, one notable aspect of this sample that needs to be considered is that the participants were all adolescents; the Theory of Planned Behavior has successfully explained health behaviors in past research, but it may not have as great of efficacy with a younger population of adolescents. Self-controlled behaviors are difficult for adolescents and reward sensitivity is high during this developmental period (Duckworth & Steinberg, 2015). It may be the case that positive attitudes, positive social influence, and adequate resources and knowledge pertaining to physical activity may increase behavioral intent in adolescents, but adolescents may not yet be able to effectively regulate their own behavior toward a long-term goal of being active in light of short-term rewards. For example, an adolescent may have a positive view of physical activity, have parents who support an active lifestyle, and have all the resources they need to get active, but the young individual may still find difficulty switching from playing video games to going outside and getting active in light of constant short-term rewards from video gaming.

Notably, one of the major benefits to using the Theory of Planned Behavior model is that it attempts to explain the discrepancy between behavioral intent and enacted behavior (Ajzen, 2005). Interestingly, the present study shows significant relationships between attitude, subjective norms, and perceived behavioral control and behavioral

intent. Perhaps the models could be adjusted to better explain the disconnect from predicting adolescent intent to exercise and predicting actual adolescent physical activity behaviors. Perhaps perceived behavioral control is not the main mediator between behavioral intent and enacted behavior for this age group. Given previous discussion of adolescence concerning the ongoing development of self-control, it may be possible that self-control could be a significant, alternative mediating factor. Additionally, along the same lines, considerable development occurs between the ages of 12-17, and age could be included as a moderator to help delineate how the model could change to more accurately reflect decision-making by this age group.

Limitations

As previously mentioned, there are limitations to the present study that should be considered when digesting study results. Notably, it is possible the model did not fit the data well because initial survey questions were not designed to reflect Theory of Planned Behavior concepts. While items used to represent Theory of Planned Behavior concepts showed face validity and met standards for use according to the model's progenitor, they may not have been entirely accurate in their reflection of model concepts.

Another limitation of this study is that all concepts used in modeling adolescent physical activity were ultimately derived from self-report questions. It is interesting to consider the effects of perception within the model. For example, would an individual with a positive attitude toward exercise perceive themselves as engaging in physical activity more than they actually do? While the method of estimating physical activity in adolescents has been supported through research (Saint-Maurice & Welk, 2015), there

were still significant discrepancies between perceived level of physical activity and actual physical activity measured via biometric devices.

Future Directions

In line with study limitations, it may be important for future researchers interested in exploring the efficacy of the Theory of Planned Behavior to use measures that have been validated to represent Theory of Planned Behavior constructs. This is an important direction as the Theory of Planned Behavior is widely studied and used, and significant contributions to this literature may necessitate validated representation of Theory of Planned Behavior constructs. It is difficult to exact how this study's results play a role in conversation surrounding the theory without appropriately validated measures of its constructs.

Additionally, future research in this area should explore the effects of age in the model's ability to explain health related behaviors in adolescents. Adolescence is a period of life marked by numerous environmental and developmental changes. Individuals in this period of development, while fostering a sense of independence, still rely heavily on parents or other family supports. Thus, physical activity decisions may reflect differential levels of parent involvement and varying levels of cognitive development.

APPENDIX

Survey Items Used in Statistical Analysis

Attitude

1. During a typical week, I don't like to exercise

(1) Strongly disagree, (2) Somewhat disagree, (3) Neither disagree nor agree,

(4) Somewhat agree, (5) Strongly agree

2. If I were to be physically active most days of the week, it would be fun

(1) Strongly disagree, (2) Somewhat disagree, (3) Neither disagree nor agree,

(4) Somewhat agree, (5) Strongly agree

Subjective Norms

1. During a typical week, my friends exercise most days of the week

(1) Strongly disagree, (2) Somewhat disagree, (3) Neither disagree nor agree,

(4) Somewhat agree, (5) Strongly agree

2. During a typical week, my family doesn't like to exercise

(1) Strongly disagree, (2) Somewhat disagree, (3) Neither disagree nor agree,

(4) Somewhat agree, (5) Strongly agree

3. I would exercise most days of the week because others would be upset with me if I didn't

(1) Strongly disagree, (2) Somewhat disagree, (3) Neither disagree nor agree,

(4) Somewhat agree, (5) Strongly agree

4. My parent(s) try to be physically active when I am around

(1) Strongly disagree, (2) Somewhat disagree, (3) Neither disagree nor agree,

(4) Somewhat agree, (5) Strongly agree

Perceived Behavioral Control

1. My parent(s) take me places where I can be physically active

(1) Strongly disagree, (2) Somewhat disagree, (3) Neither disagree nor agree,

(4) Somewhat agree, (5) Strongly agree

2. I feel confident in my ability to exercise regularly

(1) Strongly disagree, (2) Somewhat disagree, (3) Neither disagree nor agree,

(4) Somewhat agree, (5) Strongly agree

Behavioral Intent

1. I would exercise most days of the week because, I have thought about it and decided that I want to exercise

(1) Strongly disagree, (2) Somewhat disagree, (3) Neither disagree nor agree,

(4) Somewhat agree, (5) Strongly agree

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